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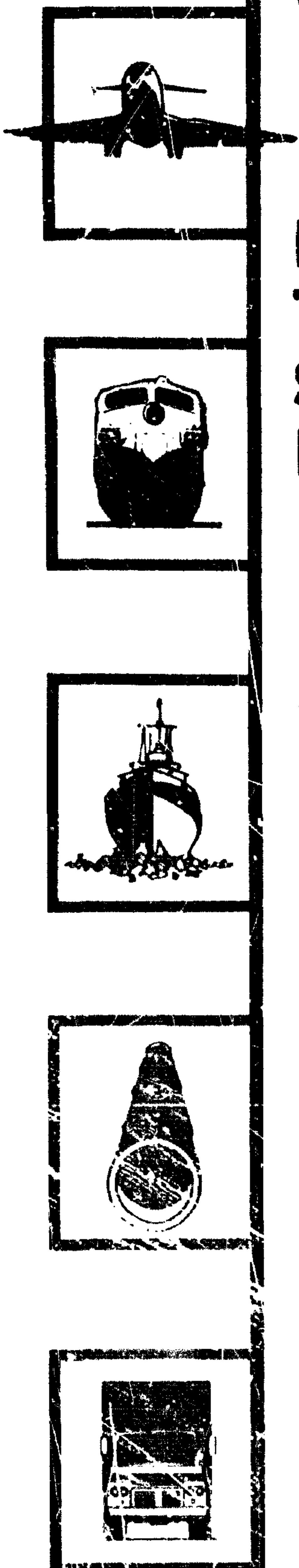

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SAFETY STUDY

AIRPORT CERTIFICATION AND OPERATIONS

NTSB/SS-84/02

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16. Abstract The study evaluates (1) the nature and scope of regulations governing airport certification, (2) the Federal Aviation Administration's (FAA) method of assuring compliance with the regulations, and (3) the FAA's airport inspections. The study discusses facility and equipment conditions and airport programs and procedures which exist to satisfy regulatory requirements, such as bird hazard reduction, snow removal, fuel storage and handling, public protection, ground vehicle operation, crash-fire-rescue training, condition assessment and reporting, and emergency plan exercises. The study discusses the complex issues of obstructions, noise abatement procedures, and land use which have plagued airports, landowners, and local authorities for years, and their relationship to the potential for loss and destruction as a result of accidents in residential or commercial areas which have surrounded and constrained some airports.

The study analyzed air carrier (Part 121) accidents occurring in the United States from 1964 to 1981 in which airplanes had traversed areas adjacent to runways. These encroachment-type accidents included overshoots, undershoots, and veer offs (loss of directional control). The substantial decrease in rates of all encroachment accidents during the postcertification period (1973 through 1981) and the consistently low rate of air carrier overshoot accidents which has existed since 1977 were noteworthy. The study also highlights a continuing concern with the possibility of overrun accidents at airports with shorter runways in poor weather conditions and the potential consequences of all encroachment-type accidents.

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WASHINGTON, D.C. 20594

SAFETY STUDY

Adopted: April 11, 1984

AIRPORT CERTIFICATION AND OPERATIONS

INTRODUCTION

The Federal government has long been concerned with the safety of aircraft operations on or near airports. In a 1952 directive, which established a temporary Airport Commission chaired by James H. Doolittle, President Harry S. Truman wrote, ". . . I have been seriously concerned about airplane accidents, both commercial and military, that have occurred in the take-off and landing of aircraft, especially in heavily populated areas. . . ." In directing that a study of airport location and use be undertaken by the Airport Commission, the President stated that: ". . . provision must be made for the safety, welfare and peace of mind of the people living in close proximity to airports . . . ." The President also instructed the commission to give recognition ". . . to the importance of a progressive and efficient aviation industry in our national economy. . . ." The Airport Commission report recommended action to alleviate problems involving location and use of airports, and the report proposed policies and procedures for the sound and orderly development of a national system of airports. 1/

Interest in the issue of airport safety again peaked in the late 1960's when the General Accounting Office (GAO) initiated a review of the Federal Aviation Administration's (FAA) control and inspection of public airports, and Congress considered legislation to provide for the expansion and improvement of the nation's airport and airway system. During this review, the GAO found that, although the FAA had general authority under the Federal Aviation Act of 1958 to establish minimum mandatory safety standards for air carrier and general aviation airports, no specific program existed to evaluate the safety of public airports. The GAO reported that the FAA was relying on airport inspections under other programs that did not have safety as a primary objective to provide safety overview. The GAO also found that:

> In 1967, the Agency [FAA] conducted a test safety inspection program at 32 public airports and found conditions that could cause accidents. Some of these conditions were previously unknown to the Agency and to airport management. An Agency official said that this program had been discontinued because [limitations] established by the Department of Transportation had not permitted the Agency to obtain the necessary additional manpower. . . . 2/

While its review was in progress, the GAO furnished its interim findings regarding airport safety inspection to congressional committees considering bills for improvement of the nation's airport and airway system. At congressional hearings in 1969, the GAO findings were supplemented by information obtained in the course of accident investigations conducted by the National Transportation Safety Board and by testimony

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1/ "The Airport and Its Neighbors--The Report of the President's Airport Commission," May 16, 1952.
2/ "Report to the Congress--Airport Safety Inspection Program Needed to Improve Flight Safety of Civil Aircraft," B-164497(1), January 15, 1971, p. 1.

reflecting the extensive, collective experience of airport user organizations. During the legislative process, the House Committee on Interstate and Foreign Commerce issued report No. 91-601, dated October 27, 1969, which summarized concisely the need for a specific airport certification program:

> Standards for airport construction, operation, and maintenance have been developed, but these are not mandatory, nor does the Federal Government certify that these standards are met. On most air carrier airports the airport owner has contracted to adhere to Federal standards but there is now no assurance that the contractual obligations are being maintained. Even in cases of noncompliance with the standards, the remedies available are limited to withholding Federal grants where they exist, but this still does not assure the safety hazard has been promptly corrected or, better yet, not allowed to develop.

In May 1970, the Congress passed Public Law 91-258, Airport and Airway Development Act, which amended the Federal Aviation Act of 1958 by empowering the FAA "... to issue airport operating certificates to airports serving air carriers certificated by the Civil Aeronautics Board [CAB] and to establish minimum safety standards for the operation of such airports." The act also required anyone "... desiring to operate an airport serving air carriers certificated by the Civil Aeronautics Board ..." to file an application for an airport operating certificate.

To implement the legislative mandate for an airport certification program, the FAA developed Part 139 of Title 14 of the Code of Federal Regulations (CFR) which addressed a wide range of airport facilities, services, physical features, and operating procedures. Part 139 was issued in June 1972 and became effective on July 21, 1972; the airports to which Part 139 applied were required to obtain operating certificates by May 20, 1973.

Despite improvements growing out of the legislative and program initiatives taken to improve airport safety, the Safety Board, in the course of its accident investigations and study activities, continued to uncover concerns regarding airport safety. For example, since 1976 the Safety Board has issued recommendations concerning:

- o Currency of airport operations manuals
- o Crash-fire-rescue capabilities
- o Emergency and disaster planning
- o Fuel storage and dispensing procedures
- o Delethalization of safety areas around airports
- o Runway surface condition testing and maintenance
- o Wet runway effect on airplane performance
- o Bird hazard mitigation

In 1982, accidents near Washington National Airport, 3/ at Boston Logan Airport, 4/ and near New Orleans International Airport 5/ tragically involved many

3/ Aircraft Accident Report--"Air Florida, Inc., Boeing 737-222, N62AF, Collision with 14th Street Bridge, near Washington National Airport, Washington, D.C., January 13, 1982" (NTSB-AAR-82-8).
4/ Aircraft Accident Report--"World Airways, Inc., Flight 30H, McDonnell Douglas DC-10-30, Boston Logan International Airport, Boston, Massachusetts, January 23, 1982" (NTSB-AAR-82-15).
5/ Aircraft Accident Report--"Pan American World Airways, Inc., Clipper 759, Boeing 727-235, N4737, New Orleans International Airport, Kenner, Louisiana, July 9, 1982" (NTSB-AAR-83-2).

long-standing concerns for the safety of aircraft operations in the airport environment. In response to the significant safety issues raised by the Washington and Boston accidents, the Safety Board conducted a special investigation 6/ to explore the problems of large airplane operation on contaminated 7/ runways. This special investigation focused on information about runway conditions and their relationship to airplane performance, as well as problems in communicating such information among the various elements of the air transportation system.

In October 1982, the Safety Board initiated this safety study of airport certification and operations to examine in depth two of the three major elements of airport safety--maintenance and operation of airport facilities and airport physical features. The third major element, aircraft operation, is addressed only briefly in this study, because it is an extensive topic which involves several complex facets such as design and performance of aircraft, development and application of operational procedures, reliability and availability of navigational aids, and the accuracy and timeliness of communicating important information in the airport environment.

This safety study examines the background and scope of 14 CFR Part 139 as it concerns the maintenance and operation of airport facilities; the FAA's administration of the airport certification program; the results of certification activities; airport physical limitations; and other related safety considerations. Based on the results of this study the Safety Board makes 21 recommendations to the FAA seeking to improve safety at airports.

STUDY METHOD

The Safety Board formed a five-person study team to explore the following general areas:

- o Airport facility operation and maintenance
- o Crash-fire-rescue capability
- o FAA regional management and airport management perspectives of the certification program
- o Aircraft operating considerations

Selected for the study were airports that would permit comparison of airport certification and surveillance methods employed by different FAA regional offices as well as observation of operations at some physically limited older facilities and some less constrained newer airports located in the same geographical area. Parameters considered included passenger enplanements, runway length, safety area characteristics, dates of construction or modification, accident and incident histories, and approach area characteristics. All but one of the airports chosen were selected from among the 36 large hub airports, 8/ which handle a large number of total aircraft departures, serve the

6/ Special Investigation Report--"Large Airplane Operation on Contaminated Runways" (NTSB-SIR-83-2).

7/ "Contaminated" as used in the referenced report and in this report means that ice, snow, slush, water, or rubber deposits have accumulated on the runway to the extent that airplane performance is affected measurably.

8/ According to the Civil Aeronautics Board report "Airport Activity Statistics of Certificated Route Air Carriers" for 1981, the 36 large hub airports serve 24 major population centers which account for 70 percent of all revenue passenger enplanements. In contrast, the 43 medium hub airports serve only 19 percent of the revenue passenger enplanements, and the small hub airports account for about 7.5 percent of the revenue passenger enplanements.

largest volume of revenue passengers, and are located in geographical areas served by more than one certificated airport (see appendix A, table XIX). After weighing these considerations, obtaining the viewpoints of representatives of the Air Line Pilots Association, the Airport Operators Council International, and the American Association of Airport Executives, a group of 14 airports in 7 different FAA regions was chosen, including 5 airport pairs. The airports chosen for study were: Washington National, Dulles International, Kennedy International, New York LaGuardia, Los Angeles International, Burbank-Glendale-Pasadena, Houston Intercontinental, Houston Hobby, Chicago O'Hare, Chicago Midway, San Diego Lindbergh, Denver Stapleton, Boston Logan, and Ft. Lauderdale-Hollywood. (The size, operational activity, and reasons for including each airport in the study group are documented in appendix A, tables I and II.)

Team members, working individually and collectively, defined the information that was to be gathered in each area of interest and how the information could be used to attain the study objectives of assessing airport certification activities and identifying potential safety problems associated with physical limitations at airports. Although the airport certification process does not cover approach procedures, navigational facility operation, or aircraft operations, such matters cannot be dismissed in any discussion of airport safety; therefore, some operational concerns such as noise abatement, and navigational aid problems also are discussed in this report.

AIRPORT CERTIFICATION PROGRAM

Background and Scope of 14 CFR Part 139

The intent of Congress in enacting legislation to require the certification of airports is summarized in the following excerpt from the Report of the House Committee on Interstate and Foreign Commerce, No. 91-601, dated October 27, 1969:

> The airport is an instrumentality of interstate and foreign commerce. It is used by the public and the manner in which it is maintained and operated is vital to the public safety. It is in the public interest that the airport be certificated by the Federal Government as to its adequacy for the safe conduct of flight operations in the national air transportation system.

To implement the legislative mandate for airport certification contained in the Airport and Airway Development Act of 1970, the FAA promulgated 14 CFR Part 139, Certification and Operations: Land Airports Serving CAB-Certificated Scheduled Air Carriers Operating Large Aircraft. Part 139 was issued on June 12, 1972, and became effective on July 21, 1972. The airports to which Part 139 applied were required to obtain operating certificates by May 20, 1973. The FAA also amended 14 CFR Part 121 to prohibit, after May 20, 1973, operations by air carriers 9/ into airports that do not hold airport operating certificates.

Under Part 139, two types of airport operating certificates can be issued--a "full" certificate and a "limited" certificate. Land airports serving scheduled air carriers operating large aircraft need a full certificate; however, airports serving air carriers conducting only unscheduled operations or operations with small aircraft can apply for a

---

9/ Air carrier as used in Part 139 refers to those air carriers holding a certificate of public convenience and necessity issued by the CAB.

limited certificate. To obtain a full certificate, an airport must comply with all provisions of Part 139, unless exemptions from particular requirements are granted by the FAA. A limited certificate may be issued to an airport when the FAA ". . . finds that it would be contrary to the public interest to require compliance with all applicable requirements of this Part [139], and that the airport is otherwise properly and adequately equipped to conduct a safe operation for the kind of air carrier operation proposed." All the airports surveyed in this study had full airport operating certificates.

To develop Part 139, the FAA formed a study group to delineate airport certification requirements and plan for their implementation. The study group, composed of staff from FAA's Airport Service, Flight Standards Service, and Air Traffic Service offices, stated that airport safety depended upon:

- Airport design
- Aircraft operations
- Maintenance and protection of airport facilities

Of these three elements, only the last was not being monitored by an existing FAA inspection program; therefore, the study group believed that airport facility maintenance, protection, and operation should be covered by the airport certification program. Within these broad guidelines, specific requirements in Part 139 were developed, and many were revised over the following decade. In general, Part 139 rules pertain to maintenance and operation of "airside facilities" in the airport operating area; terminal facilities, vehicular access to the airport, and other "landside" considerations are not included in Part 139 regulations. (The airport facilities and operations which must meet 14 CFR Part 139 requirements are described by the applicable section in appendix A, table III.)

The most recent legislative mandate affecting airport certification, the Airport and Airway Improvement Act of 1982 (Public Law 97-248), revised the requirement defining which airports must be certificated by the FAA. Under the Act, airports ". . . that serve any scheduled or unscheduled passenger operation of air carrier aircraft designed for more than 30 passenger seats" must obtain an airport operating certificate. The effects of this new provision, in terms of increasing or decreasing the number of certificated airports, is being evaluated by the FAA.

Program Administration

The airport certification program is administered by the FAA regional offices by a certification inspection staff within the regional Airports Division. In addition to certification and surveillance responsibilities, the Airports Division handles:

- Airport planning
- Environmental assessment
- Airport planning grants and airport development grants
- Airport compliance with design and construction standards

The airport certification inspection staff may be located physically in the FAA regional office or in an Airport District Office that may be separated geographically from the regional headquarters. Although airport certification is managed regionally, the Safety and Compliance Division within the Office of Airport Standards at FAA Headquarters directly advises regional staff and maintains certification activity records in order to monitor program effectiveness.

The principal process used by the FAA to implement the airport certification program is the facility inspection. Airport inspections are the basis for determining if an airport's facilities, maintenance, and operations meet the regulatory requirements of Part 139. FAA Order 5280.5, 10/ which contains policy guidance and standard procedures for FAA personnel to conduct the certification program, gives the following policy guidance for inspection activities:

> 102. General. The certification program operates under the philosophy that the airport operator's self-inspection program, resulting in the day-to-day compliance with applicable safety regulations, is the primary responsibility of airport management. The airport certification onsite inspection actually results in an evaluation of the adequacy of the operators' procedures on self-inspection, notification, corrective maintenance and planning that are continually in effect.

In effect, the FAA certification inspectors are evaluating periodically the airport operators' day-to-day procedures for maintaining and operating the facility in compliance with Federal standards, as well as assuring that the airport fully complies with 14 CFR Part 139.

The qualifications for an airport certification safety inspector are listed in paragraph 14 of FAA Order 5280.5 which, in part, states:

> ...the incumbent should possess a broad knowledge of airport and aircraft operations with emphasis on visual navigational aids, lighting and marking, obstructions, operational surfaces, fire and rescue service, passenger and public protection and emergency planning. He/she should have a working knowledge and understanding of Federal Statutes. He/she should be able to deal effectively on controversial matters with a wide variety of officials and groups involved in airport management, and in agency review and regulation of airport activities.

The types of inspections performed as part of certification program activities are defined in FAA Order 5280.5 as:

> Initial Inspection: First inspection conducted by an airport certification safety inspector prior to approval for certification.
>
> Annual Inspection: Conducted annually to insure full compliance with [14 CFR] Part 139. A full record and report of the inspection must be made.
>
> Follow-up Inspections: Conducted as deemed necess[illegible] certification personnel in each region. Normally they wou[illegible] check on significant problem areas or by a call from th[illegible] manager. They are very flexible in coverage but a record must [illegible] made of the visit.

10/ Federal Aviation Administration Order 5280.5, Airport Certification Program Handbook, March 21, 1977, reprinted June 1982 (includes change 1).

<u>Surveillance Inspections</u>: Conducted under the circumstances which dictate a deviation from normal notification procedures. This may be the result of a marginal annual inspection, an unexpected opportunity to "stop" in while flying enroute to another airport or a deliberate effort to test the airport's continued compliance with [14 CFR] Part 139 requirements.

FAA Order 5280.5 also describes various tasks which should be accomplished during inspections. Figure 1 shows how the certification process relates to other FAA services and segments of the aviation and local communities. The certification inspection process is portrayed above the dashed line in figure 1, which shows the key elements of the inspection--review of the airport operations manual and other preinspection preparation, contacting other FAA services for information regarding possible problems, onsite inspection of airport facilities and procedures, review of airport selfinspection capabilities, and determining corrective measures dictated by inspection findings. The activities related to the certification process but not a part of it are shown below the dashed line in figure 1.

Some criteria by which inspectors can judge an airport's compliance with the Federal requirements in the various sections of Part 139 are given in FAA Order 5280.5; however, many of these criteria are presented in qualitative terms, which lead to subjective evaluations by certification inspectors. The following examples of subjective criteria for sections of Part 139 are from FAA Order 5280.5:

> <u>Personnel - 139.23 and 139.81.</u> The certification inspector will determine that:
>
> (1) The airport has made provisions for <u>sufficient</u> <u>qualified</u> personnel to conduct daily safety inspections, routine maintenance, removal of snow, airport fire fighting. . .
>
> * * *
>
> <u>Fire Fighting and Rescue - 139.49 and 139.89.</u> The certification inspector will determine that: . . .
>
> * * *
>
> (3) The airport has available <u>trained</u> personnel to insure that all required vehicles are operational. . .
>
> * * *
>
> <u>Hazardous Material - 139.51.</u> The certification inspector will determine that: . . .
>
> * * *
>
> (3) The airport manager or a tenant, as the fueling agent has <u>trained</u> personnel, <u>safe</u> procedures for storage, dispersing and handling fuel, lubricants and oxygen on the airport. [Emphasis added]

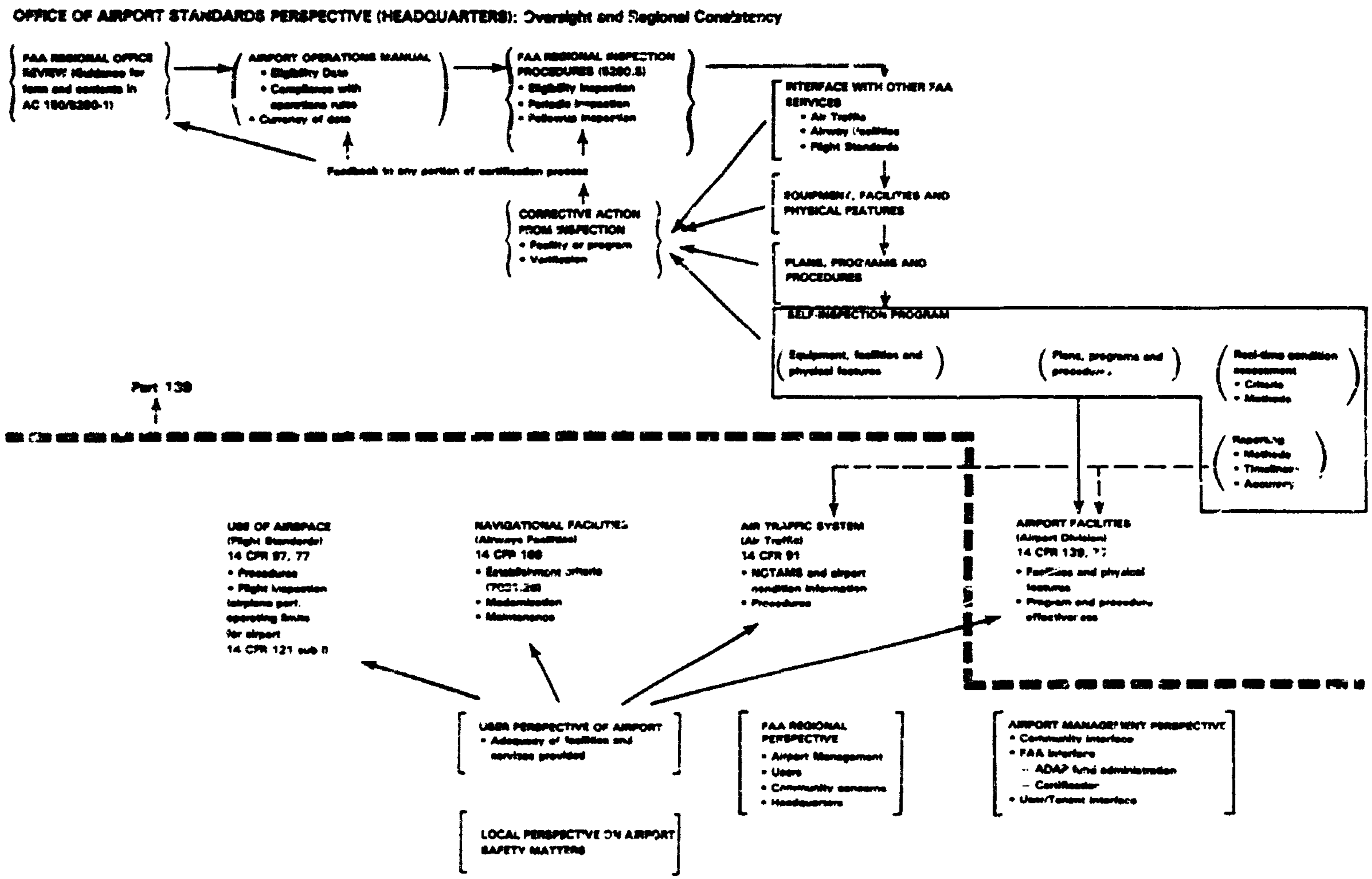


Figure 1.--Airport certification program and other FAA activities related to terminal area operations.

In each of these examples, the inspector would have to make a subjective decision about the underlined words because there are no guidelines for qualitative descriptors such as "sufficient," "qualified," "trained," or "safe" in FAA Order 5280.5.

The subjectivity inherent in aspects of the airport inspection process are acknowledged in the airport certification inspector requirements stated in paragraph 13 of FAA Order 5280.5:

> REQUIREMENTS. The certification safety inspector is engaged in inspections of airport operations, airport physical layout, visual navigational aids, and other related factors to determine compliance with [14 CFR] Part 139.... The inspector must make qualitative rather than quantitative judgements regarding each of the required standards.

Analysis of the Program

The basic tasks in evaluating a program are defining the program goals, measuring the degree to which goals or objectives have been achieved, and defining the process used to pursue the objectives so that any changes needed to enhance program effectiveness can be made intelligently. The objective of the airport certification program, clearly articulated in the legislative mandate, is stated in FAA Order 5280.5 as follows:

> ...to provide a reasonable program for the enhancement of airport safety in a manner beneficial to the aviation industry.

The airport certification program is intended to achieve safety improvements by requiring proper maintenance and operation of airport facilities, recommending the upgrading of facilities, and assuring the availability of rescue and emergency services should a need arise. Therefore, as one possible measure or indicator of safety enhancement, the Safety Board studied statistical information that described airport facility improvement. Aircraft accident and incident data for the 18-year period 1964 through 1981 which included the inception of the certification program also were examined as a potential indicator of improved airport safety. The significance of rescue and emergency services was assessed through a review of accident site location data for the 18-year period 1964 through 1981.

Many improvements in airport facilities have been made in the past decade (see table 1). For example, between 1971 and 1981 the number of air carrier airports with at least one instrument landing system (ILS) has increased by 87 percent. In 1971, none of the 578 air carrier airports with at least one runway longer than 4,000 feet was subject to periodic facility and procedure review; by 1983, 662 airports had operating certificates and were subject to periodic inspection and surveillance. Although information regarding the number of airports in 1971 with at least one runway with surface treatment designed to improve friction is not available, a survey in 1983 indicated that 255 airports serving commercial turbojets (nearly 50 percent of all full certificate airports) have at least one runway with a surface treatment. The number of visual approach slope indicator (VASI) light systems, which provide vertical guidance to pilots, has increased more than 10 times (1,042 percent) since 1971.

Table 1.--Descriptive statistics for certificated airports

	1971	1980-1983
Number of instrument landing systems (ILS) installed at air carrier airports in U.S. and territories	280	523 (1981 data)
Number of air carrier airports with at least one runway longer than	578 (None was certificated)	662 (as of May 1983) Full certificate: 526 Limited certificate: 136 4,000 feet
Airports with at least one runway having a surface treated to improve traction	Not available	363 (as of July 1983)
Total number of runways with surface treatment	Not available	490 (as of July 1983) Grooved: 281 Porous friction: 109 Others: 100
Airports serving commercial turbojet aircraft with at least one surface-treated runway	Not available	255 (as of July 1983) One treated runway: 183 More than one treated runway: 72
Number of visual approach slope indicator (VASI) light systems at air carrier airports	119	1,359 on 913 runways at airports certificated for air carrier operation

To determine if the upgrading and regular inspection and surveillance of airside facilities has had a measurable effect on airport safety, the study team reviewed aviation accidents and incidents in which airport facilities, conditions, or personnel had been cited by the Safety Board as a cause or contributing factor for the 18-year period from 1964 through 1981. Since airports were required to have operating certificates in 1973 to serve CAB-certificated air carriers, comparisons were made (in most cases) between numbers and rates of accidents and incidents which occurred in the 9-year period (1964 through 1972) before certification and numbers and rates of accidents and incidents which occurred in the 9-year period (1973 through 1981) after certification.

For example, the total number of air carrier (14 CFR Part 121) aircraft accidents occurring in the United States dropped from 1,002 in the 9-year precertification period to 499 in the 9-year postcertification period. The total number of airport-related 11/ accidents and incidents involving all types of aircraft was 3,236 in the precertification period (1964 through 1972) and 3,375 in the postcertification period (see appendix A, table IV). Airport-related accidents accounted for 6.8 percent of all accidents in the precertification period, and airport-related accidents were 7.8 percent of

11/ Those accidents or incidents in which airport facilities, conditions, or staff were cited by the Safety Board as a cause or contributing factor.

all accidents in the postcertification period. The level of airport-related accidents in comparison to all accidents remained stable at a relatively low percentage for the pre- and postcertification periods. However, the rate of airport-related accidents decreased 11 percent from 8.9 accidents per million operations 12/ in the precertification period to 7.9 in the postcertification period. Airport-related accidents involving air carrier aircraft decreased from 63 in the precertification period to 52 after certification; this represented a 20-percent decrease in the rate of airport-related air carrier accidents from the precertification period to the postcertification period.

The yearly rates of all airport-related accidents decreased from 11.9 accidents per million operations in 1973 to 3.9 in 1980 (see appendix A, table V). The yearly rates of airport-related accidents involving air carriers for the years 1979 through 1981 (0.19, 0.30, and 0.42) were substantially lower than the 9-year period rate of 0.60 accident per million operations. While the number of fatal airport-related air carrier accidents increased from 1 in the 9-year precertification period to 3 in the similar postcertification period (see appendix A, table IV), the Safety Board did not consider it to be of statistical significance, because the number of accidents was so small that any change would cause large rate variations of dubious significance.

The airport certification regulations require that firefighting and rescue services be available at certificated airports in accordance with index standards established in Part 139. Although these services will not prevent accidents, they may significantly increase the survivability of certain types of crashes which occur within reach of the emergency equipment. An examination of the number of accidents which occurred within reach of the crash-fire-rescue service (see table 2) revealed that 51 percent of the air carrier accidents in the precertification period (1964 through 1972) occurred on the airport, where rescue and emergency services may have influenced accident survivability. About 13 percent of the precertification period accidents that occurred on the airport also involved a fire. In the postcertification period (1973 through 1981), 53 percent of the air carrier accidents occurred on the airport, and 18 percent of those involved a fire. While the number of air carrier accidents occurring on airports decreased 50 percent in the postcertification period, the 138 postcertification, on-airport air carrier accidents indicated a continuing need for emergency services at airports.

The number of airport-related accidents at each of the 14 airports selected for this study is relatively small (see appendix A, tables VI through IX), and the accident rates at these airports for each 9-year period were substantially less than the overall rate in the period for accidents at all airports in the United States.

The reduction in the postcertification-period, airport-related accident rates and the trends of decreasing rates of airport-related accidents in recent years indicates a measurable safety improvement at airports. Although the improvement cannot be directly correlated to the certification program because of the presence of other influencing factors that cannot be quantified, such as technological improvements in aircraft systems, upgraded navigational facilities, improved operational training, and increased operational awareness of terminal area difficulties, the trend is encouraging.

To assess further the safety improvement effectiveness of the airport certification program in recent years, the Safety Board studied the FAA's inspections of facilities, maintenance, and operations; fuel storage and dispensing; and crash-fire-rescue capabilities at the 14 study airports.

12/ Operation is defined as a takeoff or landing in the FAA Air Traffic Activity Statistics report.

Table 2.--Accident site location of
U.S. air carrier accidents and incidents occurring in the United States
(including U.S. territories and possessions)

	1964-1972		1973-1981	
	All	Fire	All	Fire
Incidents				
Total	457	12	237	5
Accidents				
Total	545	86	262	39
Fatal	95	51	41	20
Fatalities	1,815	1,304	1,097	1,048
Serious injuries	626	334	505	174
Accidents on airport				
Total	279	35	138	25
Fatal	22	10	14	7
Fatalities	118	114	239	230
Serious injuries	190	94	277	94
Accidents within 1 mile				
Total	45	16	7	4
Fatal	13	10	5	4
Fatalities	274	269	398	396
Serious injuries	67	58	33	32
Accidents from 1 to 5 miles				
Total	26	10	12	5
Fatel	14	9	7	4
Fatalities	253	228	253	247
Serious injuries	117	80	48	26
Accidents beyond 5 miles				
Total	195	25	105	5
Fatal	46	22	15	5
Fatalities	1,170	693	207	175
Serious injuries	252	102	147	22

FAA Inspections of Airport Facilities, Maintenance, and Operations.--To assess the certification program, the Safety Board compared the most recent FAA annual inspection results with Safety Board onsite survey findings for each of the 14 study airports. The Board's survey team visited 7 FAA regional offices and the 14 study airports between March 29, 1983, and June 6, 1983. During the visits to the regional offices, study team members reviewed FAA inspection files for the study airports, interviewed certification inspectors and managers, and interviewed Airways Facility Division and Air Traffic Division staff regarding the existence of any unusual or noteworthy situations at the study airports.

The Safety Board's facility checks confirmed the accuracy of FAA inspection findings for pavement area conditions (14 CFR 139.43 and 139.83) and marking and lighting runways, thresholds, and taxiways (14 CFR 139.47 and 139.87) at all but one of the study airports. At that airport, Los Angeles International, although FAA inspection records showed no pavement or lighting problems, the Safety Board found ungrooved patches over two parallel cracks running the full length of a grooved runway. The ungrooved patches were from 2 to 3 feet wide and were between 10 and 15 feet apart. Under wet runway conditions, the grooved runway surface and ungrooved patches probably would have different retarding capabilities which could affect an airplane's acceleration and stopping performance and its directional control. The Safety Board also noted damage to centerline lighting at this airport.

For the study airports, FAA inspection records regarding protection of navigational aids (14 CFR 139.63), bird hazard reduction (14 CFR 139.67), construction area marking (14 CFR 139.71), and snow removal (14 CFR 139.85) were found to be accurate, and no serious deficiencies were noted in these areas. However, the Safety Board did find that the airports had several different methods of satisfying these requirements. For example, bird hazard reduction efforts observed at the study airports included the use of bird patrol vehicles and shotguns with special shells to scare birds, the use of tainted food to make birds sick, planting different varieties of flowers, and employing an ornithologist to devise methods of reducing the local bird population. The bird problems at the study airports were being controlled, to the extent possible, and airport operations staff were well aware of the potential hazard posed by birds.

Snow removal procedures also varied among the study airports; some airport operators contracted the entire operation, while others did all removal and positioning with airport staff and equipment. Although the study airports had different procedures, each seemed to be appropriate for the local conditions, and responsible personnel were very knowledgeable about the effectiveness of procedures. Part 139 requires that procedures for airport operations, such as snow removal and positioning, be included in the airport operations manual; however, the snow removal plans are not required to have specific quantitative criteria for clearing runways or suspending operations. Inclusion of criteria, as determined by each airport and approved by the FAA in the airport operations manual, would assure greater objectivity in decisions involving snow removal and aircraft operations.

As a result of its investigation of the World Airways accident at Boston Logan on January 23, 1982, 13/ the Safety Board issued Safety Recommendation A-82-152 on December 23, 1982:

13/ Aircraft Accident Report: "World Airways, Inc., Flight 30H, McDonnell Douglas DC-10-30, Boston Logan International Airport, Boston, Massachusetts, January 23, 1982" (NTSB-AAR-82-15).

Amend 14 CFR 139.31 and 14 CFR 139.33 to require that airports certificated under 14 CFR 139 and located in areas subject to snow or freezing precipitation have an adequate snow removal plan, which includes criteria for closing, inspecting, and clearing contaminated runways following receipt of "poor" or "nil" braking action reports and to define the maximum snow or slush depth permissible for continued flight operations.

The FAA replied on April 1, 1983, that 14 CFR Part 139 was being reviewed for possible changes that would be set forth in a Notice of Proposed Rulemaking (NPRM) to be issued in the near future. To date, an NPRM has not been issued, and the recommendation remains in an "Open—Acceptable Action" status.

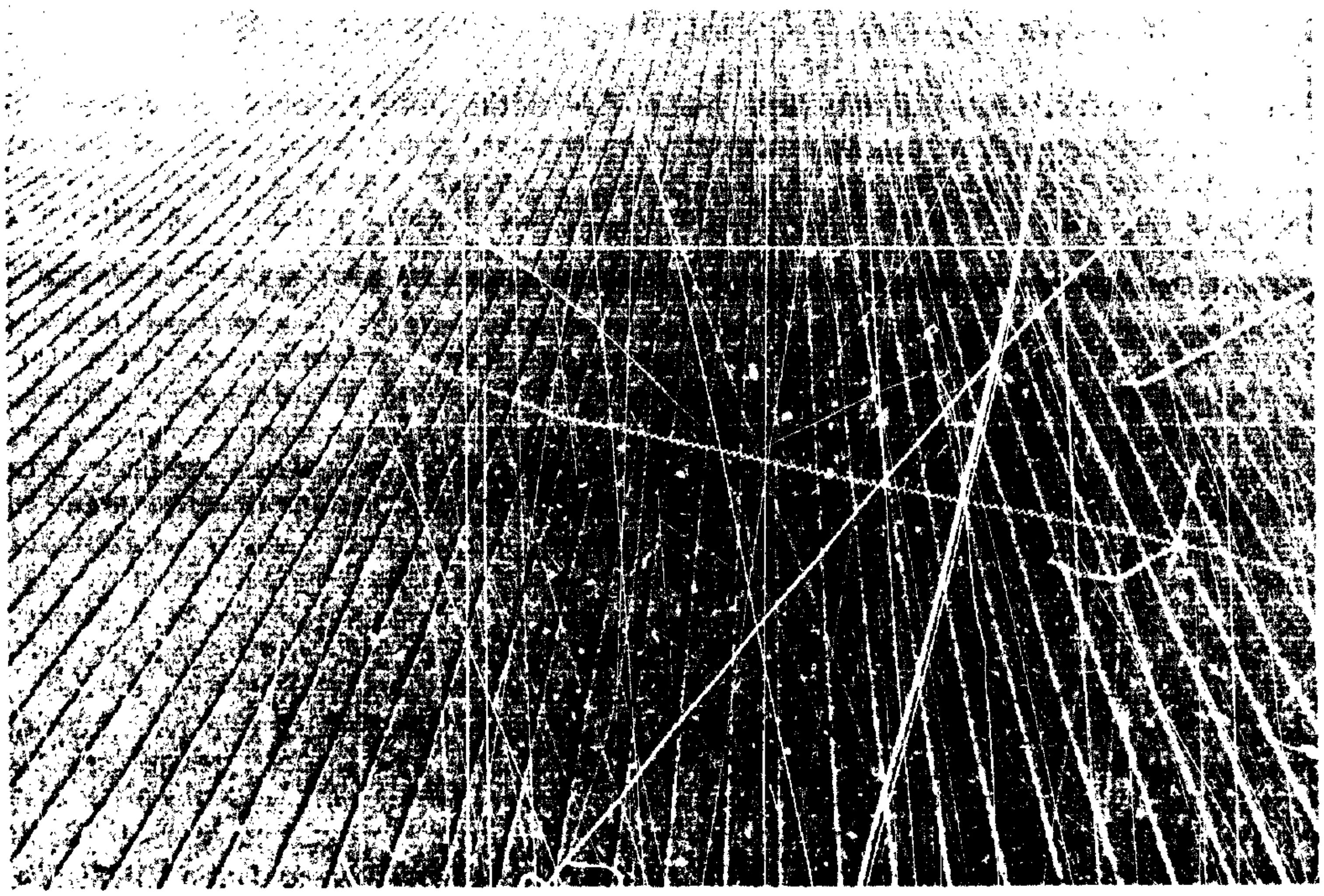
FAA inspectors had approved many different selfinspection programs (14 CFR 139.57) at the study airports, and the Safety Board found that the daily inspection procedures used at each airport were effective. In general, airport employees assigned as operations inspectors were knowledgeable and conscientious in the performance of their daily inspections. However, on one night shift inspection witnessed by a study team member at Chicago O'Hare, the operations specialist left broken runway lights adjacent to the runway and failed to report an 8-inch-square piece of asphalt which had been dislodged from the runway centerline. The day shift operations specialist at Chicago O'Hare performed a thorough and careful inspection. As a result of observing at least one of the daily airport operations area 14/ inspections at each study airport, the Board discovered that maintenance policies differed considerably. At some airports, certain conditions were allowed to go uncorrected for longer periods than at others. Examples of such conditions were:

- growth of grass through asphalt cracks on aprons, ramps, taxiways, and runup areas;
- small areas of asphalt deterioration on ramps and taxiways;
- plugged drains;
- washout areas near taxiways;
- collapsed or worn grooving on runways (examples are shown in figure 2).

Such conditions may not pose problems when they first occur, but as maintenance is delayed, more serious problems can arise. For example, deterioration of asphalt can lead to separation of larger asphalt pieces, which may become a potential hazard to aircraft operations, and collapsed grooving may lead to loss of grooving effectiveness, thus compromising the stopping performance of airplanes.

As in the case of selfinspection procedures, FAA inspectors found no problems with the condition assessment and reporting (14 CFR 139.69) methods at the study airports. The Safety Board found that a variety of equipment was used for the local dissemination

14/ The airport operations area (AOA) is an area of the airport used or intended to be used for landing, takeoff, or surface maneuvering of an aircraft.



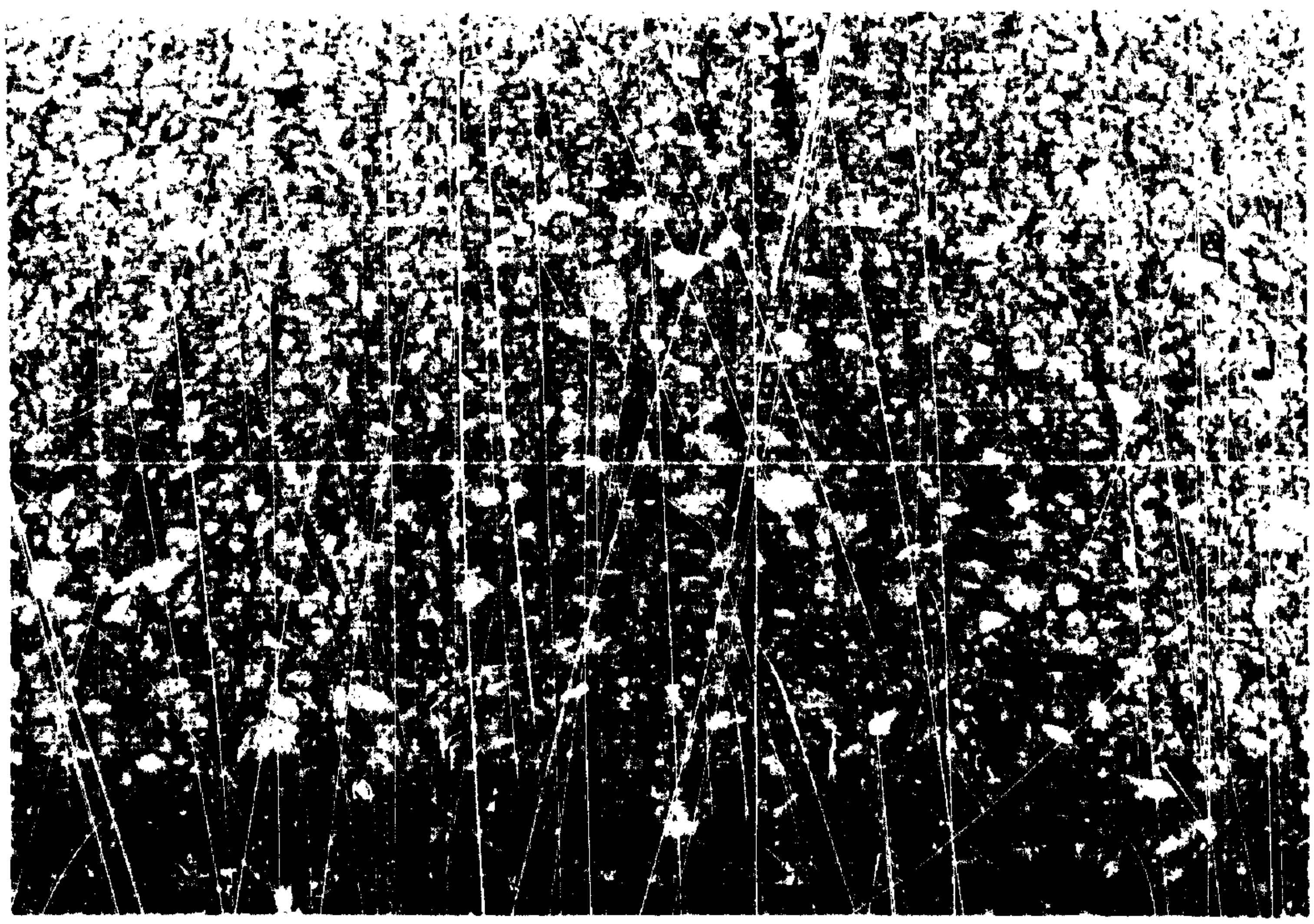


Figure 2.—Good grooving condition on runway at Boston Logan (top), and worn grooving condition on runway at Chicago O'Hare (bottom).

of airport conditions and that all airport operations personnel were using the Notice to Airmen (NOTAM) system. 15/

Runway condition assessments are made for either maintenance or operational purposes. Maintenance condition assessments may involve visual inspections of runways to detect surface deterioration or accumulation of rubber deposits or may involve measurements of runway friction coefficients at periodic intervals using a mu-meter or James decelerometer 16/ to help determine when to remove rubber deposits. Dulles International, New York La Guardia, Kennedy International, Boston Logan, and Denver Stapleton had mu-meters but used them only occasionally. Dulles International and New York La Guardia had recorded several years of coefficient of friction data for their runways, which they used in assessing runway conditions for maintenance. Runway operating conditions were evaluated at all of the study airports when a runway was covered with water, snow, slush, or ice which might reduce airplane directional control or stopping capability. At Ft. Lauderdale-Hollywood and Burbank-Glendale-Pasadena, the airport management furnished a driver and vehicle to the airport tenants so that they could inspect runway conditions and measure water depth. Similar inspections were made by operations officers at the remaining study airports during periods of inclement weather. However, at all the study airports, transmission of braking action reports (good, fair, poor, or nil) made by pilots on prior flights using a runway was the primary method of operational condition assessment used by airport management for that runway. Washington National, New York La Guardia, Chicago O'Hare, and Dulles International had runway condition sensors, which gave airport management better data on runway surface temperature and condition (wet, dry, or ice-covered). The airport managers used this information for timing snow removal operations and the application of the various types of runway compounds to improve surface friction.

The Safety Board's special investigation of airplane operation on contaminated runways 17/ already has provided an in-depth review of problems in assessing and reporting runway conditions and in performing timely maintenance, as well as the need for correlating measured surface conditions with aircraft performance data. The Board's onsite observations corroborated the conclusions of the special investigation that runway surface condition assessment for operational purposes is subjective at many certificated airports and that there is a need to pursue objective methods of providing surface condition information which is usable by operators.

No unsatisfactory trends in ground vehicle operations (14 CFR 139.59) were reported in recent FAA inspections of the study airports, but the Safety Board's survey found distinct differences in the degree of airport management control over ground vehicle operations and conditions at the various airports. Some airports, such as Boston Logan, New York La Guardia, Kennedy International, Dulles International, and Washington National, required annual inspections of all vehicles driven in the airport operations area. All study airports except Ft. Lauderdale-Hollywood, Chicago O'Hare, Chicago Midway, and Los Angeles International maintained strict driver standards through the suspension of airport operations area driving privileges in cases of poor performance. At airports where

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15/ A system of disseminating information, through periodic publication or briefings, concerning the establishment, condition, or change in any component (facility, service, or procedures) of, or hazard in, the National Airspace System, the timely knowledge of which is essential to personnel concerned with flight operations.
16/ Mechanical devices used to measure the coefficient of friction of paved surfaces.
17/ Special Investigation Report—"Large Airplane Operation on Contaminated Runways" (NTSB-SIR-83-2).

there was less vigorous control of ground vehicle operation, the Board found more recorded vehicle and aircraft collisions for the prior year than at the other airports. Vehicles with cracked windshields and inoperative headlights, and vehicles traveling at excessive speeds in the airport operations area were observed at Los Angeles International.

FAA annual inspections of public protection measures (14 CFR 139.65) at the study airports usually cited problems such as open gates or doors leading to the airport operations area and occasionally identified situations where the airport operations area could be entered by climbing over articles stored near a fence. The Safety Board found some uncertainty among certification inspectors about what an airport should do to insure public protection. One inspector considered a gate that was shut but unlocked to be acceptable, another inspector believed a gate should be locked, and a third inspector indicated that an open unmanned gate would be acceptable if the gate were roped off inside to prevent inadvertent entry. Some of the confusion results from ambiguities in the FAA regulations. Title 14 CFR 139.65, which requires a certificated airport to have "... appropriate safeguards against inadvertent entry of persons or large domestic animals onto any airport operations area," also states that airports complying with 14 CFR Part 107--Airport Security are acceptable under 14 CFR Part 139. But Part 107, which is intended to provide protection against acts of criminal violence and air piracy, requires airport operations area security to prevent "... entry of unauthorized persons and ground vehicles." Apparently, inspectors are not sure whether airport public protection measures should be required to prevent "inadvertent entry" to the airport operations area (14 CFR 139.65) or "... to control penetration of an [airport operations area] by an unauthorized person" (14 CFR 107.23). Also, 14 CFR 139.65 specifically requires safeguards against inadvertent entry of "large domestic animals" to the airport operations area; however, there is no requirement to prevent entry of wild animals, nor is there any definition of a "large domestic animal."

Some of the following situations were indicative of inconsistencies observed in implementing public protection requirements:

- Dulles International, Chicago O'Hare, and Houston Hobby had deer within airport boundaries and were working to control the problem through varied measures such as hunting, trapping, and electrical fencing;

- San Diego Lindbergh and Los Angeles International had perimeter fences that were manufactured of wood, and at Los Angeles International the supporting structure was on the outside. Houston Hobby had a 4-foot-high fence; Houston Hobby and Houston Intercontinental had wire fences with large rectangular grid patterns.

- Houston Hobby had gates that were routinely left open and unattended, with a light nylon rope used to circle an area inside the open gates;

- Three dogs were seen crossing the active runway at Houston Hobby.

<u>Fuel Storage and Dispensing</u>.--The Safety Board's assessment of the FAA's annual inspection of handling and storage of hazardous articles and materials (14 CFR 139.51) at the study airports was concentrated in two principal areas: the dispensing of aircraft fuel and surveillance of fuel service facilities. Procedures for handling other hazardous materials contained in the airport operations manuals of the study airports were detailed adequately, and no difficulties with procedures were documented during the study.

At all study airports except Dulles International and Burbank-Glendale-Pasadena, the Safety Board saw fueling service discrepancies which included leaking fuel trucks, fuel trucks without fire extinguishers, trucks on which the fuel type was not easily identified, fueling being performed without grounding, and fueling being performed without securing (chocking) the wheels of the truck. A review of FAA annual inspection records for these airports did not show any similar observations by FAA inspectors. Records at one regional office indicated that inspectors were uncertain about what bonding and grounding procedures should be considered acceptable during fueling operations.

Extensive comments on prior inspection reports about fuel handling and storage were found at only one of the regional offices surveyed. While fuel storage inspection is an annual requirement, the Safety Board found that many of the FAA certification inspectors have no experience or formal training in the operation of fuel storage facilities, nor do they have standard guidelines to use during the inspection process. The Board found this apparent lack of surveillance capability to be disturbing. Although National Fire Protection Association (NFPA) 18/ records showed that only one minor fuel storage fire has occurred on an airport, several cases of nonairport storage facility accidents involving similar storage facilities resulted in loss of life and extensive property damage, and illustrated vividly the potential for a significant airport safety problem.

The Safety Board also found that a fundamental disagreement existed between airport operators and the FAA regarding an airport's responsibilities under 14 CFR 139.51(b) which requires that "the airport (or its tenant) as the fueling agent have an adequate number of trained personnel and procedures to safely dispense aviation fuel." Airport managers said that holding the certificated airport responsible for tenant fueling agent operations is unfair and that adequate surveillance of fueling operations would impose a severe financial burden on the airport. The airport managers further argued that they are not held responsible for the quality of airplane maintenance or flight training of their fixed base operations (FBO) or for certificating those individuals conducting such services and that they did not understand why one segment of an FBO's services (fueling) was being singled out. Many airport managers believed that fuelers should be licensed by the FAA as are pilots and mechanics. Since the responsibility for aviation safety is shared by pilots, mechanics, and fuelers, the FAA should ensure that a minimum level of competency for fuelers is required by instituting a certification program.

The South Chapter of the American Association of Airport Executives (AAAE) in its annual winter meeting at El Paso, Texas, on February 18, 1982, resolved to petition the FAA to change 14 CFR 139.51(b). The AAAE's petition was published in the Federal Register on September 2, 1982, (docket No. 23071) and was denied by the FAA on July 7, 1983. The FAA's position was and remains that the issuance of an airport operating certificate should be dependent on a determination that the entire airport meets the safety requirements of 14 CFR Part 139. The FAA expects the certificate holders to exercise enough control over the tenants to insure that they are conducting a safe operation. The FAA believes that the airports can accomplish this with the contractual (landlord) leverage already available and employed in other aspects of the landlord/tenant relationship. The argument for FAA licensing of fuelers was not addressed.

18/ The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects, and to secure the cooperation of its members and the public in establishing proper safeguards against loss of life and property by fire.

The attitude that airport management should not be responsible for fuel management prevailed at several of the airports visited, and the managers at these airports did not have a complete understanding of the training program and/or the operation of the fuel storage facilities of their fuel service tenants. However, because of FAA regional concern with past accidents caused by the use of improper fuel in aircraft, airport managers in the FAA's Southwest Region appeared to be keenly aware of the overall operation of their fuel service facilities. For example, Houston Hobby has 28 fuel service facilities, and airport management seemed to understand each operation. Houston Hobby, unlike 90 percent of the airports visited, has a "fuels specialist" on the airport staff, who requires each fuel service facility to submit a summary of training in fuel handling and a fuel plan for the fuel storage area. Each is reviewed by the fuels specialist and entered in the airport operations manual.

The Safety Board's concern that the FAA's inspection personnel had too limited knowledge of storage facilities led to study team visits of 30 fuel service facilities for the purpose of identifying problems. The facilities surveyed ranged from operations pumping 24,000 gallons a year to operations in which annual fuel usage exceeds 1 billion gallons. Management personnel were interviewed at each facility about:

- Turnover, hiring, and training of refueling personnel;
- Mechanical condition of fuel service vehicles;
- Fuel storage facilities.

At the completion of each interview, the Safety Board visited the fuel storage facility, accompanied by a management representative to answer questions that might arise.

Only two of the facilities visited administered a prehire test for aptitude. Three facilities required potential employees to furnish a certified copy of their State driving record and license. About 75 percent of the fuel service facilities hired people "off the street" for refueling positions. The remaining facilities elevated personnel to a refueling position from within company ranks. Roughly 90 percent of the facilities that hired people "off the street" preferred that the prospective employee have some aviation and/or fueling experience; however, this was not mandatory.

Each facility required a new employee to read company safety, operations, and quality control manuals and attest to having done so by signing a statement. This was the only classroom or self-study training for new refueling employees at 20 percent of the fuel service facilities visited. The remaining 80 percent had tests on refueling procedures and some audiovisual presentations. The larger fuel service facilities (approximately 60 percent of those visited) used written tests and audiovisual presentations made available by the airlines with which they had contracts, and about 20 percent of the facilities produced their own training program tailored specifically to their type of operation.

All of the fuel service facilities incorporated some on-the-job training. Typically a new employee would be assigned to the facility's fueling specialist for such training. On the average, it took about 2 weeks of training before the new employee could begin limited fueling operations on his own. Checkout to "full performance level" was dependent upon the number and type of airplanes serviced by the facility. Each airline has a set procedure which they expect the fueler to know and use, and spot checks are conducted by the airlines to ensure that these procedures are being used.

Managers of all of the fuel service facilities visited said that they reviewed safe airport driving practices with new hires. However, only two of the facilities required the employee to pass a driver's test; one of these facilities was located on an airport that required new airport employees to pass a driving test administered by airport authorities.

Managers of all of the facilities visited said that they reviewed the use of fire extinguishers with new hires as part of the employee's training. However, only five facilities provided new hires with the "hands on" practical use of a fire extinguisher. In these instances the new hires demonstrated their skill at extinguishing a hot fire contained in a 50-gallon drum. Some airports were unable to provide hot fire training for fuel service personnel because of local ordinances prohibiting open air fires.

Only four facilities had some type of recurrent training for fuel service personnel, which varied from an oral question-and-answer period to an observation and critique of the fueler's performance.

The majority of the fuel service facilities used old fueling vehicles--in some cases nearly 20 years old--but most of the vehicles appeared to be in good mechanical condition. Managers said that vehicle maintenance was good. All of the facilities required a condition inspection of their fueling vehicles, and nearly every facility required that the vehicle inspection be performed with a company inspection checklist tailored to the fueling vehicles. However, only one facility published a minimum requirement checklist which provided specific guidelines to be used in deciding whether to accept or reject a vehicle.

At most of the facilities a condition check of each fueling vehicle was performed daily, usually prior to the first trip of the day, by a fueler/driver. At three facilities an auto mechanic had the inspection responsibility. At one facility inspections were performed weekly by auto mechanics. Two facilities required inspections prior to each vehicle movement. Several airports also required vehicle inspections. For example, at Denver, the Stapleton International Airport Fire Department inspects fueling vehicles semiannually. At Boston Logan, the Massachusetts Port Authority, in cooperation with the State police, conducts annual safety inspections of fueling vehicles.

Most of the fuel storage facilities at the 14 study airports were old--in some cases over 40 years old--and settling of storage tanks over long periods has resulted in leakage into the ground at some facilities. While not considered a fire or explosion hazard, leakage into the ground is a serious environmental concern. When these facilities were built, they were located in remote sections of the airport. Through the years, both on- and off-airport construction has caused the distance buffer between the storage facilities and highly traversed areas to be diminished greatly. Washington National, Houston Hobby, and Fort Lauderdale-Hollywood are prime examples of this encroachment. Heavily used public roadways lie just a few feet away from the fuel storage facilities on these airports. The existing buffer distance criteria established by the NFPA consider storage facility design and structural integrity to determine buffer distances which range from a few feet to the diameter of a storage tank. Design features which minimize the risk and effects of explosion permit a reduction of the buffer distance.

All of the fuel storage areas were surrounded by chain link fencing, approximately 8 feet high, with the gate secured by a lock. No major or recurring vandalism was reported at any of the facilities.

Spills occurring during aircraft fueling were not considered to be a major problem at any of the airports visited. Although many spills did occur, the airport and fuel facility managers said that the number of spills and gallonage of fuel involved was quite small in proportion to the number of fueling operations performed each day. Fuel spills of 5 gallons or more were reported at all of the study airports. Many study airports required spills of 1 gallon or more to be reported. The crash-fire-rescue units responded to all reported fuel spills to provide fire protection during cleanup activities. A review of fuel spill incident records at the airports involving aircraft fueling operations revealed that the majority of them were caused by mechanical defects in the aircraft's fuel tank overfill vent valves.

Every fuel storage facility had experienced a fuel spill. In some cases the spill amounted to several thousand gallons. Most of these larger spills were caused either by defective valves or fittings or by the failure of overflow warning devices to alert fuel service personnel.

At half of the facilities visited, "Emergency Fuel Shut Off Switches" were not readily identifiable (placarded), and at one storage facility on the north end of Washington National, there was no fire alarm hookup to the airport fire department. Fuel service personnel relied on two-way radios in the fueling vehicles to notify the fire department. As a result of the Safety Board's finding, an alarm system has been installed at this storage facility.

The overfill sensing system is designed to protect against the overflow of petroleum distribution tanks during the filling operation. Three types of overfill sensing methods were observed at the storage facilities:

- Roughly 20 percent of the facilities performed a visual check prior to and after receiving fuel.

- Approximately 50 percent of the fuel storage facilities had a mechanical float, high-level sensing system. As the fuel rises, the float also is supposed to rise. At a preset height, the float is designed to activate a switch which in turn sets off an aural alarm, thereby alerting the fueling attendant to cease the fueling operation. Several of the fuel service facilities that incorporated mechanical overfill sensors in their storage tanks had no procedure to check their reliability. Several facilities used an additional mechanical float sensor known as the "High High Sensor."

- The third type of overfill sensing system incorporated either a mechanical or electronic optical sensor. Instead of depending on the fueling attendant to shut down the fueling operation, the sensors performed the shutoff electrically.

About 50 percent of the facilities periodically checked their overfill warning systems. However, nearly all of the fuel service facility managers interviewed indicated that mechanical sensing systems were not very accurate or reliable, and checking the operation of these mechanical systems was difficult or in some cases impossible. For example, one facility the Safety Board visited had a high-level alarm system which was not equipped with a means to check its operation. Fuel spills have occurred at this facility because the mechanical sensing system failed to activate and thus alert personnel to halt the fueling operation. At another facility the mechanical high-level overfill sensor failed its last alarm test.

Overfill hazards and reliability problems have prompted a number of entities to undertake remedial measures. For example, the Department of the Navy has a program to replace mechanical overfill devices with electronic sensors throughout its fuel storage facilities, and Michigan has a State law that requires each terminal having a tank filled by pipeline to be equipped with a high-level alarm system that must be tested every 3 months. In 1980, to eliminate past problems with the old float shutoff in the holding tanks, American Airlines upgraded its New York La Guardia fuel storage facility by installing optic liquid-leveling sensors to activate an automatic shutoff. A proposal is currently before an NFPA committee to expand the requirement for high-level alarm systems to include a procedure for checking on a scheduled basis their accuracy and reliability.

Under the Airport and Airway Improvement Act of 1982, the FAA was authorized to continue the allocation of funds for airport development and planning which began under the provisions of the Airport and Airway Development Act of 1970. According to the FAA Office of Airport Planning and Programming, monies from the Airport and Airway Trust Fund cannot be used to upgrade fuel storage facilities unless a storage facility relocation is necessitated by a project that is considered eligible for funding, such as a runway extension. The FAA considers fuel storage facility improvement projects to be the responsibility of the airport.

Crash-Fire-Rescue Capabilities.--The Safety Board's review of FAA annual inspections of crash-fire-rescue equipment and services (14 CFR 139.49 and 139.89) and emergency plans (14 CFR 139.55) for the study airports showed that all airports complied with the requirements of Part 139. The onsite survey of emergency capabilities showed a wide variation in the equipment, resources, and procedures at the study airports. Table 3, a tabulation of crash-fire-rescue indicators at the 14 study airports, groups the airports by a crash-fire-rescue index, which is a means of specifying the requirements for firefighting equipment and extinguishing agents established in 14 CFR 139.49(b). The index applicable to an airport is determined by "the longest large aircraft, operated by an air carrier user, with an average of five or more scheduled departures per day."

The tabulation shows the airports at which the crash-fire-rescue service is also responsible for structural (buildings) fire protection as well as aircraft protection. Also indicated are the total number of firefighting vehicles at each airport and the number of persons assigned to crash-fire-rescue service per operating shift. Title 14 CFR 139.49(b) requires at least three firefighting vehicles for index C, D, and E airports. Chicago Midway met the minimum requirements; all other study airports exceeded the minimum vehicle requirements of the regulation. The average number of vehicles at airports having no structural firefighting responsibility was 5.6, which exceeded minimum requirements by 87 percent. The minimum staffing requirements of 14 CFR 139.49(h) call for: ". . . sufficiently qualified personnel to insure at least 85 percent of the required maximum agent discharge rate of firefighting equipment." Since most firefighting equipment has a turret system which enables the operator to meet the 85 percent discharge requirements, it is theoretically possible that the regulatory requirement could be met with as few as three people--one person who could drive the vehicle and then operate the turret system for each of the three vehicles. However, the staffing of crash-fire-rescue services at all study airports exceeded this theoretical minimum. Guidance given in a 1967 Advisory Circular (AC) 150/5210-6, "Aircraft Fire Fighting and

Table 3.—Crash-fire-rescue capabilities and activities for study airports.

Airport Index	Airport Identifier	Structural Responsible	Number of Vehicles	Manpower Per Shift	Amount in Gallons or Pounds					Yearly Activities		
					Water	Foam	AFFF	Premix	Dry Chemical	Total	Aircraft Emergency	Fuel Spills
E Aircraft Longer Than 200 ft.	ORD	Yes	15	52	15,580	0	2120	0	2400	503	175	102
	JFK	No	7	10	11,250	1296	0	250	1800	942	321	59
	IAD	Yes	8	15	14,355	500	1136	0	2700	723	56	25
	BOS	Yes	5	8	11,660	1621	0	0	1000	2034	176	209
	DEN	No	8	11	9,000	750	860	50	450	697	287	109
	LAX	No	6	16	14,000	0	2030	2000	1360	817	220	147
D Aircraft 160-200 ft.	IAH	No	9	26	9,050	0	1020	100	3000	197	66	113
	FLL	No	4	11	7,500	0	1200	0	1370	1955	171	77
	SAN	No	4	8	6,000	0	1000	200	500	162	18	24
	LGA	No	5	6	7,500	864	0	125	900	683	239	253
C Aircraft 135-160 ft.	DCA	Yes	7	13	3,730	0	560	200	1600	1001	80	21
	MDW	No	3	3	3,200	300	180	0	700	63	42	7
	HOU	No	4	10	5,030	150	310	0	1660	141	68	70
	BUR	Yes	6	21	13,500	0	1675	0	700	798	29	40

Rescue Personnel and Personnel Clothing," which was cancelled and not replaced, recommended at least two persons per truck to obtain the desired potential of each type of truck. The lowest staffing level found was six persons per shift at New York La Guardia, which had no structural firefighting responsibility, and the highest staffing, 52 persons per shift, was found at Chicago O'Hare, which did have structural responsibility. The average per shift manpower at study airports with no structural firefighting requirement was 11.7, 290 percent greater than the minimum required.

Part 139 specifies two different minimum water quantity requirements for firefighting. The larger quantity is required if protein foam is used. However, if aqueous film forming foam (AFFF) is substituted for protein foam, the water quantity can be reduced. The Safety Board found that all study airports exceeded their respective water quantity requirements, and all but Denver Stapleton and San Diego Lindbergh exceeded the dry chemical extinguishing agent minimum. Table 3 shows the water and extinguishing agent quantities available strictly for aircraft crash-fire-rescue purposes; water and agents for structural firefighting were not tabulated. Index E airports exceeded water capacity requirements by 90 percent to 160 percent; and with one exception, airports in this index exceeded dry chemical requirements by more than 100 percent. Index D airports had 88 percent to 225 percent more water than required, and at index C airports the minimum was exceeded by 50 percent to 540 percent. The NFPA and the International Civil Aviation Organization (ICAO), of which the United States is a member, have published guidelines for water and dry chemical agent quantity similar to those of Part 139. ICAO and NFPA quantity recommendations exceed the Part 139 minimum requirements. Beyond the minimal requirements prescribed by Part 139, the FAA, in AC 150/5210-6B, "Aircraft Fire and Rescue Facilities and Extinguishing Agents," dated January 26, 1973, also described recommended levels of protection which are comparable to ICAO standards. NFPA, ICAO, FAA Part 139, and FAA AC 150/5210-6B specifications for comparable airport index or category are presented in table 4, where the differences in recommended or required quantities are apparent. The study airports not only exceeded FAA minimum standards for water quantity, they all exceeded the more demanding NFPA guidelines and ICAO member requirements; all except Denver Stapleton and San Diego Lindbergh (one index E and one index D) exceeded the dry chemical levels recommended by ICAO and NFPA.

If the degree to which study airports voluntarily exceeded the minimum requirements for manpower, equipment, and extinguishing agents of Part 139 is typical, then the adequacy of the minimum levels established by the FAA appear to be questionable, especially since the FAA advisory publication recommends higher levels based on research, test data, and experience.

Title 14 CFR 139.49(i) requires that crash-fire-rescue personnel be "...familiar with the operation of the firefighting and rescue equipment and understand the basic principles of firefighting and rescue techniques." The FAA's AC 139.49-1, AC 150/5210-12, and AC 150/5280-1 list several topics for crash-fire-rescue personnel training. However, these AC's are only advisory, and they are subject to interpretation. FAA certification inspectors also are given some guidance in training program evaluation in paragraph 137(c) and (d) of FAA Order 5280.5 which states:

> c. An effective training program to develop and maintain a high level of proficiency would normally include the following:
>
> (1) Basic training in the use and maintenance of personal fire fighting equipment and vehicles.

Table 4.--Comparison of extinguishing agent quantities.

Index or Category: FAA	ICAO	NFPA	FAA Part 139: Gallons of water for AFFF / Lbs of dry chemical	ICAO: Gallons of water for AFFF / Lbs of dry chemical	NFPA: Gallons of water for AFFF / Lbs of dry chemical
C	7	6	2,100 (3,140)* / 500 or 450/50 (1,000)*	3,200 / 500	3,335 / 500
D	8	7	2,800 (4,740) / 500 or 450/50 (1,500)*	4,800 / 1,000	5,000 / 1,000
E	9	8	4,200 (6,350)* / 500 or 450/50 (1,500)*	6,400 / 1,000	6,665 / 1,000

*Quantities recommended in FAA Advisory Circular 150/5210-6B

(2) Tactical training which covers the "how and when" to use various fire extinguishing agents.

(3) Deployment of men and equipment to accomplish the rapid control of a fire in order to protect the emergency evacuation procedures and permit rescue operations.

(4) First aid training.

(5) Live drills. Recurrent training for firemen where each man participates in at least two live burns per year, using protective clothing, hand lines, and the extinguishing agent.

(6) Coverage of the airport emergency plan, mutual aid program and the role of the fire fighting personnel in these plans.

(7) Coverage of the emergency evacuation procedures, the location and operation of emergency exits from the outside for the types of aircraft that serve the airport, the use of rescue tools and forceable entry equipment, and the necessary precautions employed during these operations.

d. Live drills (fighting practice fires) afford the trainee an opportunity to learn the capabilities and limitations of extinguishing agents, fire suppression systems (pumps, turrets, hose lines, etc.) and protective clothing.

The Safety Board found that all of the study airports had good basic and tactical training programs (items 1 and 2 above), as well as first aid training (item 4). Training programs for deployment of men and equipment (item 3) varied. Some crash-fire-rescue units carried out at least one mock drill per shift where all equipment was dispatched to a vehicle or aircraft parked on a taxiway or inactive runway. Others only deployed equipment in response to a standby call for an actual emergency. Deployment of equipment also could be practiced during live drills (item 5) if the fire pit was accessible from all sides. However, the Safety Board found that access to many of the fire pits was limited and that some airports did not have a fire pit. Most of the study airports had conducted emergency drills (item 6); some alternated full-scale drills with table-top simulation exercises on an "every-other-year" basis. Only table-top simulations were conducted at a few airports because managers were concerned that full-scale drills caused local traffic congestion and, in their opinion, wasted manpower.

The Safety Board believes that full-scale exercises of emergency plans usually reveal problems which would not be apparent in a table-top demonstration. For example, the Board's investigation of an accident at Detroit Metropolitan Wayne County Airport on January 11, 1983, 19/ revealed some problems with notification procedures outlined in the emergency plan which had not been fully exercised since September 1978. The airplane involved carried a container of radioactive material (RAM), which fortunately was not breached in the accident. However, none of the effective Federal, company, and local regulations or agreements which outlined airport hazardous material notification procedures were implemented. It was only a coincidence that the airport operations employee overheard a discussion of the RAM shipment and notified an onscene commander. This type of situation might have been avoided if the airport emergency plan had been subjected periodically to a full-scale exercise. Currently, there is no requirement to exercise the plan; however, guidelines provided for certification inspectors in FAA Order 5280.5 recommend that the emergency plan be exercised annually. The Safety Board found that, in general, FAA inspectors were encouraging the study airports to conduct live drills and full-scale emergency exercises.

The weakest area of training the Safety Board observed was in familiarization with new airplanes. None of the crash-fire-rescue units at the study airports had training diagrams of the DC-9-80, or the Boeing 757 or 767. The study airport crash-fire-rescue personnel indicated that familiarization was accomplished only when a new airplane began serving the airport and that training sessions usually were conducted by maintenance personnel of air carriers using the new equipment. Some crash-fire-rescue units stated that familiarization was difficult unless the new airplane remained at the airport overnight. This aspect of crash-fire-rescue training is very important because it provides

19/ Aircraft Accident Report--"United Airlines Flight 2885, McDonnell-Douglas DC-8 54F, N8053O, Detroit, Michigan, January 11, 1983" (NTSB-AAR-83-7).

personnel with vital firefighting and rescue information such as the position and locking mechanism of normal and emergency exits, aircraft cabin configuration, seating arrangements, location and operation of the equipment and service access doors and configuration of fuel and electrical power systems. Although this knowledge can be acquired by studying airplane emergency system diagrams, there is no substitute for periodic familiarization with the airplane.

Although Part 139 rules and FAA Order 5280.5 both contain a requirement for crash-fire-rescue training and provide guidelines for the type of training, FAA inspectors have no uniform standards to use in judging the adequacy of each type of training being conducted at certificated airports. The training variations the Board found at study airports attest to the subjectivity of present criteria.

Title 14 CFR 139.49(h) requires that firefighting and rescue personnel be "appropriately clothed." General guidance for protective clothing appears in three different sections of FAA Order 5280.5. The first reference in paragraph 110(i)(10) says that the certification inspector will determine that protective clothing, such as proximity suits, is available to all firefighters. The second reference, paragraph 143(c)(4), indicates that in accepting a firefighting vehicle purchased under the Airport and Airway Development Program (ADAP), the inspector assures that ". . . auxiliary equipment and protective clothing is as specified." The third reference in paragraph 154 on protective clothing states, in part:

a. Entry suits are special suits which may be used in and around flammable liquid fires. These suits, complete with breathing equipment, are impractical due to the excessive dressing time and because many models are too bulky to use successfully.

b. Proximity clothing, consisting of hoods, coats, trousers and mittens using aluminized fabric outer surfaces have better heat reflection properties than the standard fire fighters turnout clothing and permits closer access to the fire area. . .

c. Conventional turnouts, used mainly for structural fire fighting, are designed to give substantial protection from cold, heat, water, and falling debris. . .

d. The clothing most highly recommended for aircraft fire fighting is the proximity suit if worn with the necessary lining.

Although the FAA highly recommends the proximity suit for aircraft firefighting, there is nothing in Part 139 or FAA Order 5280.5 to preclude the use of less effective protective clothing to comply with the rule in 14 CFR 139.49(h). All of the protective clothing observed at the study airports was the aluminized fabric type, although many of the suits differed in construction and in fabric weight. There were no standards available to inspectors for judging the adequacy of various types of proximity suits.

At the study airports the Safety Board found several different methods of recording the activities in which crash-fire-rescue units participated. For example, some airports recorded training deployment and emergency medical service calls, while others did not. Therefore, the crash-fire-rescue activities in table 3 only show yearly totals of all activities reported by each airport's crash-fire-rescue unit and separate yearly totals of crash-fire-rescue operations in response to aircraft emergencies and to fuel spills. Response to aircraft emergencies and to fuel spills accounted for almost 35 percent of all crash-fire-rescue activities reported. The Board did not attempt to characterize the nature of the remaining activities because of the many different activity reporting schemes being used; however, the remaining 65 percent certainly would include training activities such as equipment deployment or live drills and emergency medical services provided at some airports by crash-fire-rescue units.

FAA Regional Program Administration

As the Safety Board staff visits to the seven FAA regional offices and the 14 study airports within the regions progressed, the Board was able to construct a qualitative and quantitative picture of the methods used to administer certification program activities. Interregional annual inspection differences and differences between FAA annual inspection records and the Board's observations already have been documented. In cases where regulations were found to be vague or guidance materials highly subjective, the differences were readily discernible. However, the Board found also that other qualitative factors such as the inspector's professional background and distinct styles of management appeared to influence regional surveillance activities.

The operation and maintenance of the study airports required the attention of personnel with diverse backgrounds and experience in areas such as civil engineering, electrical engineering, firefighting and rescue, public protection and emergency planning, and aircraft operational requirements. Most FAA certification inspectors, in the seven regions visited, had in-depth experience in one of the engineering disciplines, and many were also pilots. The inspectors had to augment their professional qualifications and experience in unfamiliar areas through agency training and on-the-job experience. In each of the regions, the Board observed in annual inspection records of study airports that inspectors naturally tended to emphasize the areas corresponding to their background and experience. To overcome this tendency, five regions recently have established a form of inspection assignment rotation among inspectors. One region temporarily had assigned a new inspector to accompany an experienced inspector in another region as a means of broadening the new inspector's experience and sharpening the skills needed to perform inspections. An annual conference on airport certification was the primary means of exchanging information between regions, and the methods and techniques used successfully in one region were occasionally adopted in other regions as a result of this exchange. Although certification inspectors were able to exchange information with their assigned airports by telephone or written correspondence, many inspectors stated that they were unable to attend airport operation symposiums or meetings sponsored by airports within their region because of travel funding limitations. The inspectors stated that direct participation in these airport forums provides the most effective method of exchanging ideas and views on airport topics of regional concern.

The Safety Board also observed different management styles in the regions which were reflected in the relationship with airport authorities. The styles tended to fall into one of two categories: the cooperative approach in which regional personnel tried to accomplish certification safety objectives through persuasive measures, or the more rigid approach in which the authority to inspect and require changes was firmly exercised. Since the Board staff visits to study airports did not show that deficiencies from previous inspections were allowed to go uncorrected, each approach appeared to be effective in obtaining remedial action for discrepancies found during inspection or surveillance activities. All the regions had a system of documenting airport corrective measures which were required, and each system had followup measures to monitor the progress of corrective actions.

Some regional offices appeared to have developed a degree of expertise in certain aspects of airport operations which was acknowledged by other regions surveyed. For example, fuel storage and dispensing expertise was found in one region, crash-fire-rescue expertise in another, and bird hazard reduction expertise in yet another. Regional managers and inspectors believed that the expertise evolved either from the need to deal with a particular problem related to local conditions or geography common to many airports within a region, or from individual inspector expertise or interest in an area such as crash-fire-rescue.

A comparison of airport certification workload at the seven regional offices is presented in appendix A, table X. The workload parameters computed from regional activity and resource data were number of certificated airports per inspector, number of fully certificated airports and limited certificate airports per inspector, the percentage of airport division staff involved in the airport certification program, the percentage of certification inspections performed, the percentage of noncertification inspections (utility airports), and the percentage of violations or legal actions.

The Safety Board found regional variations in the number of certificated airports assigned to inspectors as well as the number of fully certificated airports assigned to each inspector. The number of airports per inspector varied from 15 to 63, with an average of 29.5 for all seven regions. Although an inspection workload, which was well above the seven-region average, existed in the Southern and Great Lakes regions, inspectors did not feel that their certification and surveillance activities were being compromised. Most regional inspectors indicated that a workload of more than 20 to 30 certification inspections annually would allow little time for involvement in airport safety activities, such as utility airport visits, safety seminars dealing with local airport problems, or airport management meetings, that were not related to certification. The Board found that, in general, inspectors were able to perform adequately the onsite portion of the annual inspection in 1 day at airports with limited certificates and in 2 or 3 days at airports with full certificates. Most inspectors indicated that an amount of time equal to or greater than the onsite inspection was required to prepare for and follow up on inspections.

Many of the region-to-region differences in the administration of the airport certification program for which justification is not readily apparent could be reconciled through an organizational unit with the authority to resolve conflicting viewpoints. An organizational entity for airport certification, patterned after existing FAA Aircraft Certification Directorates, 20/ could draw upon regionally dispersed technical expertise to provide the best advice for development and implementation of uniform, detailed regulatory compliance criteria. The FAA's existing Aircraft Certification Directorates perform technical policy management and project management for the aircraft certification programs including type certification, original airworthiness certification, and production certification. In addition, various other regulatory and management

20/ The term "certification directorate" means an organization formed and staffed for the purpose of managing the various elements of a certification program. Currently established directorates are headed by a regional director who has final authority and responsibility and is ultimately accountable for the certification programs assigned to that directorate.

functions related to certification which had been performed in Washington Headquarters have been delegated to the directorates. According to FAA Notice N8100.6, dated February 10, 1982, Aircraft Certification Directorates were established to achieve improvements in consistency of application of airworthiness standards by establishing single-point accountability, and to assure concentrations of technical expertise which are accountable for technical decisions and policy and for improving timeliness of updating regulations, policy, advisory circulars, and other forms of technical guidance. The Transport Airplane Certification Directorate is located in the FAA's Northwest Mountain Region; similarly, the directorates for small aircraft, rotorcraft, and engines are located in the Central Region, Southwest Region, and New England Region, respectively.

The Safety Board solicited comments regarding the airport certification program from the persons involved in implementing the program in the regions. Discussions with regional managers, airport managers, and certification inspectors focused on their perceived need for a change and associated benefits and problems. FAA regional and airport management agreed that the certification program has been most beneficial to airports with lower passenger volume and limited financial resources. Beyond imposing safety standards on airports through the certification requirement, congressional legislation provided that acquisition of safety or security equipment required by Federal regulations could be financed by allocations from the Airport and Airway Trust Fund. By relating funding eligibility to certification requirements, airport and airway legislation assured that certificated airports with severe financial limitations still would have funds available for safety-related projects that otherwise might not be undertaken.

In four of the seven regions, staff said that the lack of specificity of Part 139 made the certification program difficult to administer. Although two regions preferred the flexibility provided by the present rule, the regional inconsistency in interpreting Part 139 resulting from the lack of specifics produced inappropriate variations in facilities and procedures at certificated airports. This situation could be remedied by creating an airport certification directorate to serve as the focal point for technical policy. Specific suggestions and problems related to members of the study team by regional and airport management are set out in appendix B, as well as some past findings of FAA certification program audits.

Proposed Changes to 14 CFR Part 139

The FAA convened a public meeting on July 14, 1983, to discuss updating and amending Part 139, in light of its experience with the certification program, the results of its own studies, and Safety Board and industry recommendations. The subjects proposed for discussion by the FAA included emergency plans, snow removal, safety areas, bird hazard management, fueling operations, marking and lighting of runways and taxiways, crash-fire-rescue index requirements, and crash-fire-rescue training.

Many of the changes proposed in each subject area were related directly to past Safety Board recommendations. For example, the proposal made by the FAA to clarify snow removal requirements by providing advisory circular guidance is responsive to Safety Recommendation A-82-152, 21/ which called for upgraded snow removal plans having specific criteria for runway clearing and use. Safety Recommendations A-82-87

21/ Issued on December 23, 1982; see Aircraft Accident Report--"World Airways, Inc., Flight 30H, McDonnell Douglas DC-10-30, Boston Logan International Airport, Boston, Massachusetts, January 23, 1982" (NTSB-AAR-82-15).

and -88 22/ to improve water rescue capabilities prompted an FAA proposal to require, where needed, water rescue provisions in airport emergency plans. Safety Recommendations A-77-16 and -17 23/ on safety area improvements and Safety Recommendations A-76-10 through -12 24/ for more systematic bird hazard reduction programs also were addressed by the FAA in the discussion proposals.

The Safety Board is encouraged by the FAA's announced intention to establish standards for aircraft fuelling operations and to undertake periodic surveillance to assure adherence to the standards. Since 1967, the Board has issued seven safety recommendations in this area, five of which were directed to the FAA. 25/ These recommendations addressed such topics as ramp safety, procedures and practices of fuel handling, color coding around aircraft fuel filler openings, eliminating water from fuel, and expanding 14 CFR Part 139 to include minimum specifications and design criteria for the installation, maintenance, and inspection of aviation fuel storage and dispensing systems at all airports. Two Safety Recommendations were directed to the General Aviation Manufacturers Association (GAMA) in October 1982 26/ concerning standardizing and modifying nozzle and tank openings throughout the aviation fuel distribution system. The Board's survey of fuel dispensing at the 14 study airports showed that discrepancies and confusion about inspection requirements and responsibilities still exist. The FAA's proposal for more definitive standards accompanied by periodic surveillance should improve the present situation.

The FAA introduced a proposal to modify the rule governing marking and lighting of runways, thresholds, and taxiways (14 CFR 139.47) which would require rotating beacons as well as marking and lighting consistent with the type of approaches permitted at airports. The existing rule does not require marking and lighting but only requires that any lighting provided on the airport be operable and that markings be in good condition. The proposal, while an improvement over the existing regulation, does not include a requirement for uniformly designed lighting, marking, and guidance signs. FAA advisory circulars and ICAO Annex 14 (International Standards and Recommended Practices--Aerodrome) contain guidelines for marking, lights, and guidance signs which could serve as the basis for a rule intended to require standardized airport visual aids.

The need for uniformity has been described in a January 24, 1984, letter to the Safety Board from the Air Line Pilots Association (ALPA) (see appendix C) which cited several examples, from ALPA's safety deficiency reporting system, of pilot confusion and misinterpretation caused by marking and lighting at various airports. Unfortunately, this information in response to the Safety Board's initial request for the identification of safety-related matters to be considered during airport survey visits was received after the visits were made. Therefore, the study team was not able to observe the specific situations described in the correspondence. However, the Safety Board's continuing investigation of the collision on December 23, 1983, of a Korean Airlines DC-10 cargo

22/ Issued on August 11, 1982; see Aircraft Accident Report--"Air Florida, Inc., Boeing 737-222, N62AF, Collision with 14th Street Bridge, near Washington National Airport, Washington, D.C., January 13, 1982" (NTSB-AAR-82-8).

23/ Issued on April 20, 1977; Aircraft Accident Report--"Texas International Airlines Flight 987, McDonnell Douglas DC-9-14, Stapleton International Airport, Denver, Colorado, November 16, 1976" (NTSB-AAR-77-10).

24/ Issued on March 8, 1976; Aircraft Accident Report--"Overseas National Airways Flight 032, McDonnell Douglas DC-10-30, John F. Kennedy International Airport, Jamaica, New York, November 12, 1975" (NTSB-AAR-76-19).

25/ A-67-9; A-70-50; and A-81-9, -10, and -11.

26/ A-82-140 and -141.

airplane and a Piper Chieftain commuter airplane on runway 6L/24R at Anchorage International Airport has revealed that the pilot of the DC-10, in conditions of poor visibility, entered the wrong runway and attempted to take off. The pilot stated that he did not see a runway intersection sign which would have identified the runway he was about to enter; this case and others described in appendix C appear to support a requirement for improved and standardized lighting, marking, and guidance signs to minimize confusion and enhance readability of markers and signs.

The FAA also has proposed specific standards for training requirements such as those recommended by the NFPA, which should eliminate some of the variations in crash-fire-rescue training observed at the study airports. The State of Georgia has enacted legislation to require firefighters to successfully complete training in accordance with NFPA Standards 1001 and 1003. These standards specify a method to evaluate a training curriculum for crash-fire-rescue training. The Georgia program is viewed by some as a prototype which could be used as a model for other programs. However, an FAA official observed that it is impractical and inequitable to impose "across the board" training requirements on both large and small airports. Although some differences in the training syllabus for crash-fire-rescue personnel would seem to be appropriate at larger (index C, D, and E) and smaller (index A and B) airports, the Safety Board believes that 14 CFR Part 139 must specify a minimum acceptable level of training for all certificated airports. Crash-fire-rescue personnel should be equally well prepared at all airports to handle aircraft emergencies.

The most controversial proposal introduced by the FAA at the public meeting called for lowering crash-fire-rescue vehicle requirements at index B airports from two vehicles to one, and substituting an unspecified level of crash-fire-rescue protection, which would be established in individual negotiations between the FAA and airports, for the present index A minimum requirements of one vehicle with a 3-minute response time. This proposal emanated from an FAA-commissioned study 27/ of crash-fire-rescue costs and benefits, which recommended eliminating crash-fire-rescue requirements at lower index airports because of low benefits accrued in proportion to costs. The FAA has received comments from organizations such as the NFPA and ALPA critical of the study methods and findings. The Safety Board is concerned that this proposal could lead to a safety reduction at lower indexed airports, which account for more than half of all the certificated airports and enplane about 3 percent of all passengers each year. Theoretically, under existing regulations and the proposal advanced for discussion, large jet transport aircraft could average four departures per day at index A or B airports and be virtually unprotected by crash-fire-rescue equipment. The Board views with concern any reduction in crash-fire-rescue capability and intends to carefully review any proposed rule change in this regard at such time as an NPRM to amend Part 139 is issued.

AIRPORT PHYSICAL LIMITATIONS

Accidents

The tragic consequences of the Air Florida accident at Washington, D.C., the World Airways accident at Boston, and the Pan American accident at Kenner, Louisiana, brought forth renewed expressions of concern for the safety of people residing, working, or traveling near airports, as well as for the safety of air travelers. The adequacy of

27/ "Airport Crash, Fire, and Rescue: Policy Alternatives Suitable for Further Analysis," H. H. Aerospace Design Co., May 1982, DOT/FAA/AS/82-1.

airport safety margins has been questioned, especially at older, smaller airports originally designed and built to serve airplanes powered by reciprocating engines, which typically required less runway length than the first generation of commercial turbojet airplanes. The Safety Board analyzed aircraft accidents and incidents in which airport physical limitations may have been involved to assess the significance of such limitations. Several of the 14 study airports were selected because they provided an opportunity to observe various physical constraints imposed by topographical features or community growth and their influence on operations at the airport.

The Safety Board's aircraft accident data system was used to obtain information on three selected types of accidents and incidents involving air carrier (Part 121) operators which occurred from 1964 to 1981. The types of accidents chosen for analysis were undershoots, 28/ overshoots, 29/ and veer offs, 30/ all of which involve encroachment of aircraft on areas adjacent to runways. Undershoot, overshoot, and veer off accidents were characterized for 9-year intervals (1964-1972 and 1973-1981) before and after airports were certificated. (See appendix A, tables XI, XII, and XIII.) As the Safety Board found in the case of all types of air carrier accidents (appendix A, table IV), the number of air carrier undershoot, overshoot, and veer off accidents decreased substantially in the postcertification period (1973 through 1981). The accident rates (number of accidents occurring in the United States per million air carrier operations) in the 1973 through 1981 period decreased from the rates of the prior 9 years by about 60 percent for undershoots, by 51 percent for overshoots, and by 66 percent for veer offs. In relation to all air carrier accidents which occurred in the United States for the 1973 through 1981 period, undershoots accounted for 2.4 percent, overshoots for 3.2 percent, and veer offs for 3.6 percent. Almost 10 percent of the air carrier accidents from 1973 through 1981 either involved or could have involved aircraft encroachment on areas adjacent to runways. Twenty out of 29 undershoots and overshoots in the postcertification period involved substantial damage, and two of the overshoots and two of the undershoots resulted in fatalities.

Undershoot, overshoot, and veer off accidents involving air carrier (Part 121) operators also were grouped by year and by length of the runway where the event occurred. (See appendix A, tables XIV, XV, and XVI.) Overshoots were concentrated in the runway length categories under 8,000 feet; the number of overshoots on runways less than 8,000 feet long decreased from 23 in the precertification period (1964 through 1972) to 13 in the postcertification period (1973-1981). Encouragingly, in the recent years from 1978 through 1981, only three air carrier overshoot accidents have occurred, all on runways shorter than 6,000 feet, and no overshoot accidents happened on longer runways.

Undershoot accidents in the pre- and postcertification periods were most frequently associated with the 7,000- to 8,000-foot runway length range. In the precertification period, nine undershoot occurred on approach to runways between 7,000 and 8,000 feet long; four such accidents occurred in the postcertification period. Veer off accidents

28/ Undershoot--Landing or making contact with ground or object short of the runway or other intended landing area. On VFR (visual flight rules) approaches, any contact or landing short of the runway or intended landing area while on final is coded as undershoot. On IFR (instrument flight rules) approaches, an undershoot is coded only if the field or intended landing area was in sight before contact or landing short.

29/ Overshoot--Landing too fast or too far down the runway or other intended landing area, resulting in: (a) running off the end of the landing area, including collisions which may result; (b) ground looping, nosing down, or overturning off runway or intended landing area; (c) landing beyond the intended landing area.

30/ Veer off--Loss of directional control or sudden swerve while taxiing, taking off, or landing.

between 1964 and 1981 occurred most frequently on runways longer than 10,000 feet. For example, 15 veer off accidents occurred on runways longer than 10,000 feet from 1964 through 1972, and 8 veer off accidents occurred on runways longer than 10,000 feet from 1973 through 1981.

The Safety Board also examined the most severe encroachment accident cases, in which the aircraft was destroyed, (see appendix A, table XVII) to determine if any patterns existed. Between 1964 and 1981, in cases where aircraft destruction occurred, 64 percent involved the striking of an obstacle on the ground, 73 percent were undershoots, 20 percent were overshoots, 73 percent involved turbojet aircraft, and 47 percent occurred when some form of precipitation was present.

Runway length, one of the primary indicators of physical airport constraints, appeared to have little direct relationship to the occurrence of undershoots. Factors such as the presence of some form of precipitation and availability of flight path guidance were of more significance in undershoot accidents. However, as expected, overshoots were related to runway length as well as weather conditions conducive to degrading the runway surface stopping capability. As indicated in table XVIII of appendix A, 74 percent of the air carrier overshoot accidents involving narrow-bodied, two- or three-engine turbojets between 1964 and 1981 occurred on runways shorter than 8,000 feet, and table XII shows that about half of all air carrier overshoots between 1964 and 1981 occurred in inclement weather (rain, sleet, or snow). Safety Board records also show that flightcrew operational errors were cited in nearly all encroachment accidents where causal or contributing factors were assigned. Although it is more likely that overshoots will occur on shorter runways, the Safety Board found that 11 percent of the narrow-bodied, two- or three-engine turbojet overshoots occurred on runways that were 9,000 feet or longer.

In the Safety Board's special investigation report of operations on contaminated runways, 31/ the Board discussed the runway length safety margins provided by existing FAA certification and operational standards and concluded that the FAA should adopt rules which will provide adequate runway length safety margins in relation to existing conditions. Increasing the runway length required for operations from contaminated surfaces, which could result in the need to reduce airplane operating weight at airports with shorter runways in order to avoid exceeding the runway length available, is one method of compensating for degraded stopping capability and reducing the potential for an overrun.

On December 23, 1982, the Safety Board issued 18 Safety Recommendations as a result of its investigation of the World Airways DC-10 accident at Boston Logan and the special investigation of large airplane operation on contaminated runways. Three of these recommendations, A-82-163, -164, and -165, are germane to the topic of improving safety margins through revision of certification and operational rules:

> Amend 14 CFR 25.107, 25.111, and 25.113 to require that manufacturers of transport category airplanes provide sufficient data for operators to determine the lowest decision speed (V_1) for airplane takeoff weight, ambient conditions, and departure runway length which will comply with existing takeoff criteria in the event of an engine power loss at or after reaching V_1. (A-82-163)

31/ Special Investigation Report--"Large Airplane Operation on Contaminated Runways" (NTSB-SIR-83-2).

Amend 14 CFR 121.189 and 14 CFR 135.379 to require that operators of turbine engine-powered, large transport category airplanes provide flightcrews with data from which the lowest V_1 speed complying with specified takeoff criteria can be computed. (A-82-164)

Amend 14 CFR 25.109 and 14 CFR 25.125 to require that manufacturers of transport category airplanes provide data extrapolated from demonstrated dry runway performance regarding the stopping performance of the airplane on surfaces having low friction coefficients representative of wet and icy runways, and assure that such data give proper consideration to pilot reaction times and brake antiskid control system performance. (A-82-165)

In letters to the Safety Board dated April 1, 1983, and September 20, 1983, the FAA responded to all 18 recommendations. With respect to A-82-163 through -165, the FAA indicated that the recommended revisions would be considered by a Joint Aviation/Industry Landing and Performance Task Group. While the Board agrees with this approach, it is concerned that the FAA's actions may not necessarily lead to implementation of these recommendations. Therefore, in a letter dated December 12, 1983, the Board has asked for added assurance that the task group has a clear mandate "... which will result in a requirement to provide to pilots the takeoff and landing performance data referred to in Safety Recommendations A-82-163 through -165. We continue to believe that the subject performance data could be developed for the current fleet of transport aircraft without significant resource expenditures..." These recommendations have been classified as "Open—Unacceptable Action" while the Board awaits further FAA action.

The December 14, 1983, letter to the FAA also reemphasized the Safety Board's longstanding support for improving operating safety margins at air carrier airports through the installation of runway distance markers. Runway distance markers would show the distance from the marker to the end of the runway, in the direction of operation. On January 3, 1972, the Safety Board issued Safety Recommendation A-72-3 which called upon the FAA to: "Require the installation of runway distance markers at all airports where air carrier aircraft are authorized to operate." The FAA did not implement this recommendation because it believed that potential operational problems associated with distance markers, such as the possibility of misreading a distance or the need to divert a crewmember's attention from monitoring flight instruments in order to monitor markers, made their value questionable. The FAA's reply was classified as unacceptable, and the recommendation was reiterated as a result of the Air Florida crash at Washington, D.C., and again after the World Airways DC-10 accident at Boston. Although the distance marker system should not be construed as a substitute for developing a reliable cockpit acceleration monitoring system, the Safety Board believes that distance markers would provide flightcrews with an interim means of assessing takeoff performance. It also would provide to flightcrews, on landing, a way of quickly ascertaining the amount of remaining runway and enable them to use the most effective braking techniques for the situation. We await a response from the FAA describing their current views concerning runway distance markers.

Runway-Related Safety Measures

Although adequate runway length safety margins for contaminated runway conditions would reduce overrun possibilities, the Safety Board's survey of encroachment accidents also showed that overruns have occurred on runways of 9,000 feet or longer and that undershoots may occur on any length runway. Therefore, the Safety Board investigated other measures, such as safety areas and frangible structures, which can mitigate the consequences of encroachment-type accidents.

Runway Safety Areas.--Originally, 14 CFR 139.45 contained dimensional specifications for runway safety areas which required the area to be 400 feet wide and to extend 200 feet beyond each end of a runway. The rule also required that the safety areas be "delethalized" by appropriate clearing, drainage, and surface preparation, as well as by mounting necessary equipment on frangible support structures. In 1974, the FAA amended Part 139 and deleted specific dimensions for safety areas, giving the following explanation:

> The proposal in the Notice to delete references to specific dimensions was made by the FAA in recognition of the difficulties attendant to prescribing specific standards to meet the situations found at the many airports which predated Part 139. Those standards have proven to be impracticable and unsuited to broad application. The FAA acknowledges that in particular situations the applicable FAA criteria in effect at the time of construction may not have required the runway safety area to extend a distance of 200 feet beyond the runway end. However, program experience indicates that in many cases compliance with the 200-foot requirement is practically or economically infeasible. . . .

In effect, a "grandfather clause" allowed the area adjacent to usable runways, which conformed with FAA criteria in effect at the time the runways were constructed, to be accepted as safety areas under Part 139. However, in AC 150/5335-4, "Airport Design Standards - Airports served by Air Carriers - Runway Geometrics," dated January 5, 1977, the FAA provided the following guidelines for the design of safety areas and extended safety areas:

* * * * *

c. The width of the runway safety area should be at least 500 feet. . . .

d. The runway safety area length is 400 feet (120 m) longer than the runway, extending 200 feet (60 m) beyond each runway end. For a runway with a stopway over 200 feet (60 m) in length, the runway safety area should extend to the end of the stopway.

* * * * *

a. The extended runway safety area is a rectangular area centered on the extended runway centerline. It begins at the end of the runway safety area and extends 800 feet (240 m) to a point 1,000 feet (300 m) from the runway end. Its width is the same as the runway safety area. . . .

The latest FAA design standard for transport airports, AC 150/5300-12, dated February 28, 1983, specifies that a runway safety area should be at least 500 feet wide and should extend 1,000 feet beyond each runway end. There is no longer a distinction made between safety areas and extended safety areas. At the FAA's public meeting held on July 14, 1983, to discuss ". . . areas of concern and development pertaining to the Airport Certification Program . . .", the FAA introduced a proposal which would require the upgrading of runway safety areas to current, applicable design standards anytime a runway is extended.

During the study, the Safety Board was provided the following results of a safety area survey performed by the FAA in October and November 1981 for all airports which were certificated at the time:

Number of airports in survey:	670
Number of runways used by air carriers:	1,263 (represents 2,526 runway ends)
Number of runway ends with 1,000-foot safety areas of proper width:	618
Number of runway ends with 200-foot to 1,000-foot safety areas of proper width:	1,198
Number of runway ends with safety areas less than 200 feet beyond runway end and/or less than 300 feet wide:	710

In visits to the 14 study airports, the Safety Board staff found that the dimensions of safety areas were generally acceptable in the areas along the sides of the runways. At the constrained airports, such as Washington National, New York La Guardia, Chicago Midway, Burbank-Glendale-Pasadena, San Diego Lindbergh, Houston Hobby, Boston Logan, and the safety areas at the ends of the runways were marginal or nonexistent, and there were no extended runway safety areas at these airports. There were extended runway safety areas at many of the larger airports, but even at the larger airports some safety areas were smaller in size than recommended by FAA design guidelines of AC 150/5335-4. However, because of the length of the runways at these airports, an extra margin normally is available to prevent an overrun.

The continual problem of encroachment on airports by the surrounding community, which is the result of geographical barriers and conflicting interests and improper land use planning, renders unlikely any substantial increase in the size of runway end safety areas at most airports. However, at Boston Logan the Safety Board was introduced to a possible alternative to extended runway safety areas--a unique plan which analyzed the feasibility of constructing inclined safety areas (ISA) gradually sloping downward at the ends of runways bordered by water. The concept, as described by the airport engineer and shown in a scale model (see figure 3), provides a transitional surface from the runway elevation to the water surface. The ISA would be surfaced with loose gravel or crushed stone, which provides more effective and safe arresting of aircraft than a conventional safety area. The use of an adaptation of the ISA at airports with limited hard-surface safety areas could significantly improve aircraft stopping capability in these areas, without having to increase their size. This concept, based on research into aircraft arresting with

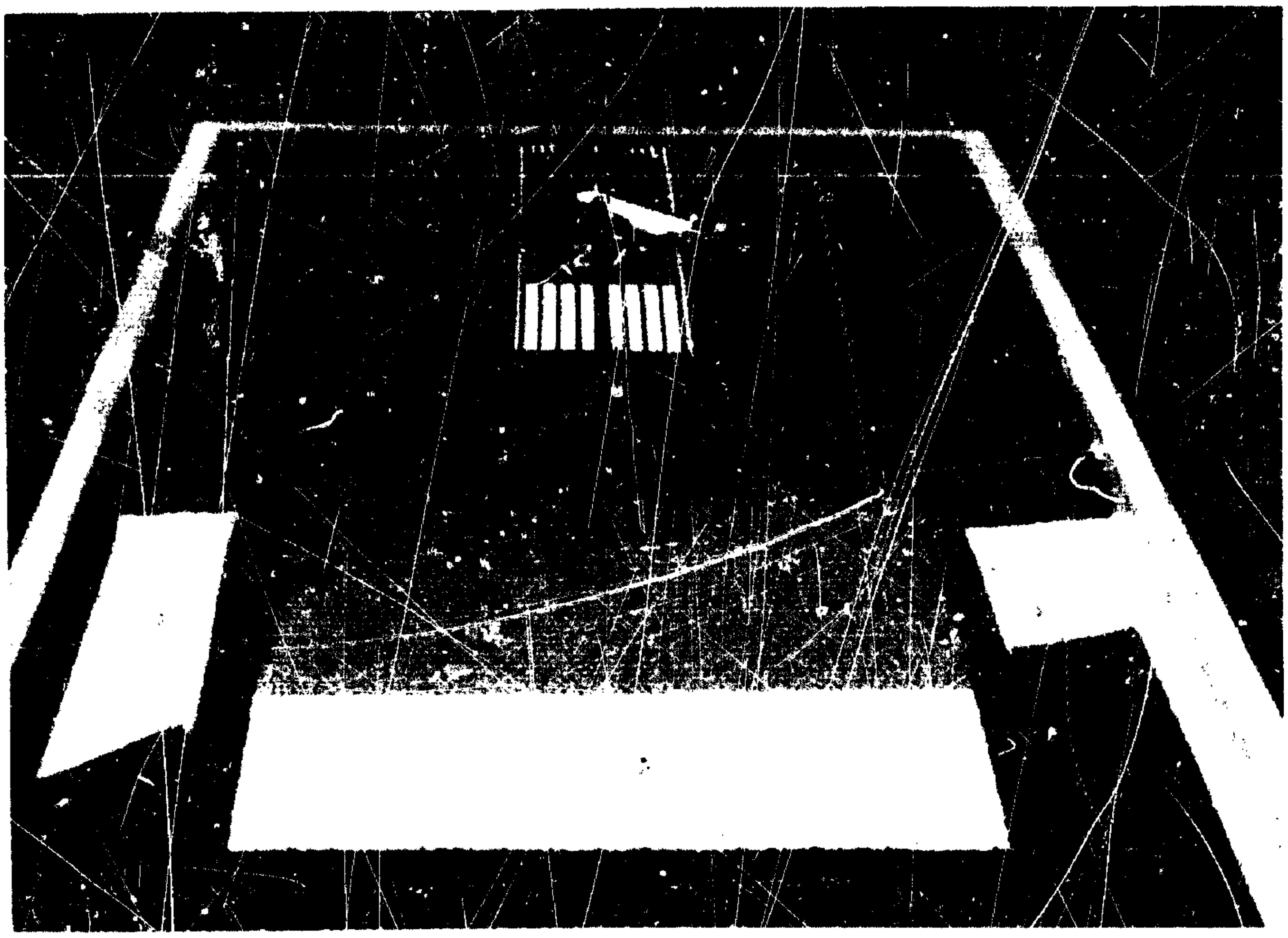

Figure 3.--Inclined safety area (ISA) scale model.

gravel surfaces performed by the Royal Aircraft Establishment, Farnborough, England, 32/ merits further consideration by the FAA.

Use of a portion of the available runway length could in some cases provide overrun protection at airports where fixed boundaries make extending a runway safety area to a length of 1,000 feet a practical impossibility. A 1,000-foot runway safety area could be provided by reducing the length of the available runway by the amount necessary to provide a 1,000-foot safety area. Of course, reducing the available runway length to achieve a 1,000-foot runway safety area in the direction of airplane operation would impose takeoff and landing weight penalties at airports with marginal safety areas and short runways. The magnitude of the weight penalty at a given airport for a particular

32/ R.A.E. Technical Report 68032, February 1968, Soft-Ground Arresting of Civil Aircraft; R.A.E. Technical Report 69001, January 1969, Soft-Ground Arresting of Civil Aircraft--Influence of Gravel Depth and Tire Inflation Pressure; R.A.E. Technical Report 71015, February 1971, Soft-Ground Arresting Civil Aircraft--Scaled Model VC10 Tests in Gravel and Sintered Fuel Ash Pellets.

model airplane will depend upon factors such as atmospheric conditions, airplane configuration, and discretionary margins provided by individual air carrier operators. As an example, the weight reduction for a 727-200 airplane was evaluated using performance data from the FAA-approved airplane flight manual for conditions representative of takeoff and landing on runway 18/36 at Washington National. Reducing available runway length to obtain a 1,000-foot runway safety area would result in takeoff weight reductions of 10 to 14 percent of the carrying capacity (passengers, cargo, and fuel) for the following conditions: flaps 25°, zero wind, standard day (59° F, 29.92 inHg), and hot day (91° F, 29.92 inHg). No landing weight penalty would result from field length reduction to achieve the 1,000-foot runway safety area because the reduced length would still exceed the length required to land at the maximum landing gross weight listed in the 727-200 airplane flight manual for the following conditions: flaps 30°, zero wind, nose brakes off, mark II anti-skid on, in both dry and wet runway conditions.

The Safety Board also examined the type of mounting used for equipment which, of necessity, is located in a safety area at the study airports. Fifty percent of the airports visited had at least one approach aid mounted on a nonfrangible stanchion. Several of the airports had multiple approach light systems that were nonfrangible. For example, New York La Guardia and Chicago O'Hare have three and six approach light systems, respectively, that are mounted on nonfrangible stanchions.

All of the airways facilities personnel at the airports visited indicated support for the use of frangible structures. Some airports, however, cannot readily incorporate frangible structures. New York La Guardia, for example, is geographically bordered by water along several runway approach corridors which precludes the use of frangible approach light structures according to the FAA's program manager for low impact resistance structures (LIRS). He states that difficulties associated with designing frangible support structures for use in water are so complex that design criteria have not been developed by the FAA or the ICAO. In present water installations, approach light bars are attached to the submerged support structures with frangible fittings, but the support structures are not frangible. Factors which complicate attempts to design submerged support structures meeting low impact resistance criteria 33/ include wave frequency and characteristics, ice pressure, and water depth variations caused by tides. It is clear that it will be a difficult task to develop design criteria for support structures strong enough to withstand the effects of water-related forces yet having low impact resistance, but additional research to resolve the problem certainly merits consideration. Other airports are unable to pursue the installation of frangible approach aid structures as actively as they would like because of workload and manpower constraints. Airway facilities personnel at Houston Hobby, for example, indicated their desire to upgrade runway 14's navigational aids system with frangible stanchions. However, because of their current workload, they do not contemplate upgrading the system in the near future.

33/ The criteria stated in "Structural/Mechanical Design Criteria for Low Impact Resistant Supports (LIRS)," FAA Report No. FAA-RD-81-28, are:

> Low Impact Resistance Structure (LIRS): shall be designed to withstand the static and operational/survival winds/jet blasts loads with a suitable factor of safety but fail readily when subjected to the sudden collision forces of 6,000 pound light weight aircraft traveling at 75 knots. The "break-away" mechanisms (joints, etc.) of the structures shall be designed to separate at a peak force no higher than 5,700 pounds acting for approximately 8 milliseconds (0.008 seconds) and absorbing no more than 700 foot pounds of energy (700 ft. lbs.). The resulting damage to the aircraft shall not be serious enough to impair a safe landing.

Since the inclusion of navigational aids as a funding-eligible item of airport development under the Airport and Airway Development Act of 1970, FAA criteria for the installation of approach light systems have stipulated the use of frangible structures. Construction using these criteria has been accomplished under this program since 1973 at numerous locations. Because of resources and other demands placed upon the FAA, it has been unable to complete the Approach Light System (ALS) program in the 3- to 5-year timeframe that was recommended by the Safety Board in 1977. At the present time, it appears that completion of the ALS retrofit program is still several years away.

In addition to the ALS frangibility program, the FAA has, in the past several years, implemented a program to upgrade the ILS approach systems with frangible localizer structures. Airways facility staff at FAA headquarters indicated that after fiscal year 1983, 187 of the approximately 268 localizer structures in the United States will be mounted so as to be frangible.

Obstructions.--Natural and man-made objects may have a significant effect on air navigation and aircraft maneuvering, particularly during landing and takeoff operations. An airport which initially may have few limitations can become limited severely in its operations as man-made objects encroach upon the boundaries, or as natural objects, such as trees, grow in areas where aircraft approach or depart the airport. Title 14 CFR 139.61 states that the airport operator is responsible for insuring that obstructions within the confines of the airport boundaries are clearly marked and lighted. The regulation does not address objects outside the airport boundaries which have been determined to be obstructions.

The President's Airport Commission in 1952 emphasized the need for States to enact appropriate legislation to protect the nation's airports from encroachment. The commission pointed out that land use below the approach and departure paths to the airports should avoid intruding on aircraft use of the airspace. Review of the present and past circumstances has disclosed that encroachment on airport boundaries continues and that the 1952 recommendations have been ignored.

Title 14 CFR Part 77, Objects Affecting Navigable Airspace, provides the rules and guidance regarding identification and study of potential obstructions on and off airport property. Part 77 applies to, "Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used therein, and apparatus of a permanent or temporary character. . . ." Not only do the standards of this rule apply to navigable airspace, but they also apply to the effect construction or alteration has on the operation of an airport. Additionally, 14 CFR 77.25, "Civil airport imaginary surfaces," sets forth the dimensional standards for pathways to the airport associated with the runways. The size of these imaginary surfaces is based on the type of instrument approach available or planned for each runway. The amount of slope and the dimensions of the approach surface are determined by the precision of the approach aid for that runway. It should be pointed out that the imaginary surfaces established by Part 77 were designed as screening or planning standards to be used only for identifying objects which may adversely affect air navigation. The regulation provides the FAA with the opportunity to take appropriate action in modifying flight procedures if the obstruction interferes with air navigation, but the FAA has not been provided with statutory authority to abate obstructions. However, the FAA does have the statutory authority under paragraphs 606 and 307 of the FAA Act of 1958 to inspect, classify, rate, and prohibit the use of unsafe public use airports.

It is the FAA's policy to emphasize the necessity to conserve the navigable airspace and to protect the air navigation facilities from encroachments whenever conflicts of interest arise over the use of the airspace. The FAA desires to satisfy both the interests of the local community and the national interest in providing safe navigable airspace. When proposed construction or alteration of a structure will create an encroachment, the FAA first considers modification of the proposal; but if an existing obstruction is involved, consideration first is given to modifying affected aeronautical operations. Presumptively, any object not meeting the standards of Subpart C of Part 77 is considered to be an obstruction and therefore to affect adversely the safe and efficient use of the navigable airspace. Any finding that the structure is not obstructive must be based on an aeronautical study by the FAA, unless the obstruction is situated with others in a previously designated area, such as an antenna farm.

The issues of land use and obstructive structures are complex matters involving conflicting interests. It is obvious that airport operators cannot exercise direct control over obstructions off the airport. Although Part 77 requires that the FAA be notified of proposed construction which might affect the airspace around an airport, the need for the FAA to use a criminal procedure to enforce this provision is a serious limitation. This topic was discussed in an FAA review in 1972 of the need ". . . to strengthen the agency's regulations and their application to all towers and other tall structures." 34/ The FAA decided that it would be beneficial to seek a change in the FAA Act of 1958 to permit a levy of a civil penalty in a case where a sponsor fails to give notice of construction as required by Part 77, rather than the criminal penalty in the Act. However, no known further action has been taken or is contemplated to change the law.

Since no Federal law prohibits local governing bodies from approving structures that can result in obstructions in navigable airspace, efforts by the FAA to control and limit the number of these hazards can be thwarted. In order to carry out its responsibilities in this area, the FAA must rely on State and local government cooperation, cooperation of sponsors of new construction, and persuasion. There appears to be good cooperation from government entities based on the record of new obstruction evaluation cases studied by the FAA in 1982. Similarly, cases based on analysis of existing airport airspace obstructions seem to have been negotiated with some success based on the 4-year record from 1979 through 1982. For example, 14,689 obstruction cases were studied in 1982, and 845 obstructions were found to be hazards. Through negotiation to relocate or lower proposed structures, the number of hazard determinations was reduced from 845 to 33. Discussions with the FAA on this point disclosed that the building of a structure classified as a hazard would be a rare exception rather than the rule; as far as the FAA knows, none of the 33 proposed structures which were determined to be hazards were ever constructed.

The Federal Communications Commission's (FCC) cooperation also has been significant in preventing the construction of numerous antenna towers that would have been obstructions to air navigation. However, the FCC does have the authority to reverse the FAA's hazard determinations.

34/ FAA memorandum dated March 13, 1972, From: General Counsel, To: AT-1, Subject: "12-13 January 1972 Director's Conference; Action and Decision Items; OA-2 letter dated 20 January 1972."

The primary effect of obstructions is to limit the usefulness of an airport, particularly in certain weather conditions. To insure safe clearance of obstructions near airports, approach procedures may have to incorporate more restrictive minimums, runway thresholds may have to be displaced, or obstacles may have to be removed. To assess the effect of obstructions at the 14 study airports (see table 5), the Safety Board looked at threshold displacements and the slopes of geometric imaginary surfaces (planes) described in 14 CFR 77.25 which are used to identify potential hazards. 35/ The Board found that there was a 7-percent reduction in total effective runway length at the study airports which was caused by threshold displacements needed to insure obstacle clearance. The airports plagued with the most close-in obstructions near the end of a runway and the steepest obstruction clearance slopes were Chicago Midway, San Diego Lindbergh, Burbank-Glendale-Pasadena, Boston Logan, and Ft. Lauderdale-Hollywood. Because of the number of variables involved in the determination of instrument approach procedure landing minimums, such as the type of navigation and approach lighting equipment and the performance of the equipment as well as terrain features and obstacles, the Board made no attempt to correlate the effect of obstructions with weather-related landing minima at the study airports.

Sharply different points of view regarding the suitability of Part 77 imaginary surface criteria were expressed to the Safety Board. A few certification inspectors and some airport managers believed that the existing slope and dimensional standards for imaginary surfaces were too restrictive and should be relaxed. However, in a letter dated January 24, 1984 (see appendix C), ALPA expressed the view that Part 77 was not strict enough because it did not contain criteria for evaluating objects encountered on departure. Evaluating the suitability of Part 77 dimensional standards for screening and identifying potential hazards to aircraft approach and departure paths is a complex task which exceeded the scope of this safety study. However, the Safety Board believes that the FAA should study and resolve the concerns and arguments advanced with respect to Part 77.

Although the Safety Board's study was confined to certificated air carrier airports, the review of airport obstruction information indicated that a more serious problem may exist at smaller, utility airports. In 1975, two accidents at such airports in which aircraft struck trees during night landing approaches prompted the Safety Board to issue Safety Recommendations A-75-81 and -82 on November 6, 1975, calling for identification of significant obstructions at public-use airports and the dissemination of such information to pilots. The airports that have precision and nonprecision instrument approaches have an increased degree of protection from obstacles and obstructions because of the approach surface standards that must be considered in approving the installation of these types of approach procedures. Utility airports that do not have instrument approach procedures to their runways do not have as high a degree of protection. The approach surface for these visual approach runways is at a slope of 20:1 instead of the 50:1 slope for instrument runways.

In response to Safety Recommendations A-75-81 and -82, the FAA instituted the Airport Safety Data Program in 1981. Under this program, governed by FAA Order 5010.4, the inspection of public-use airports, through increased participation of State aviation organizations and private contractors, has improved collection and publication of airport obstruction data. However, a Safety Board review of the obstruction data provided in the FAA's Airport/Facility Directory (AFD) found it to be of limited value for operational purposes. For example, at many utility airports objects of a permanent nature

35/ The surfaces described in 14 CFR 77.25, "Civil airport imaginary surfaces," are illustrated in figure 6-30 of FAA Order 7400.2B.

Table 5.--Runway threshold displacement and obstacle clearance parameters.

Airport (rank by longest runway)	No. of runways	Total lengths	Total length displaced threshold	Total effective runway lengths
Ft. Lauderdale (9)	3	20,292	1,889	18,403
Kennedy (1)	5	46,884	10,983*	35,901
New York La Guardia (11)	3	16,000	175	15,825
Chicago O'Hare (5)	6	43,131	0	43,131
Chicago Midway (14)	4	23,208	3,949	19,259
Los Angeles (2)	4	43,301	2,204	41,097
Burbank (12)	2	12,976	1,537	11,439
San Diego Lindbergh (3)	2	13,838	3,463	10,375
Denver Stapleton (4)	5	46,294	1,238	45,056
Houston Intercont. (3)	4	25,954	1,030	24,924
Houston Hobby (10)	4	29,422	0	29,422
Boston Logan (7)	4	27,418	2,859	24,559
Washington National (13)	3	16,936	0	16,936
Dulles (6)	5	36,082	0	36,086
		401,736	29,327	372,413

Airport	No. of 50:1 slopes	Average obstruction clearance slope	No. close-in obstructions
Ft. Lauderdale	2	31:1	0
Kennedy	5	36:1	2
New York La Guardia	3	33:1	2
Chicago O'Hare	7	44:1	1
Chicago Midway	0	0:1	8
Los Angeles	3	35:1	1
Burbank	0	2:1	3
San Diego Lindbergh	0	13:1	4
Denver Stapleton	6	45:1	0
Houston Intercont.	2	28:1	2
Houston Hobby	6	46:1	0
Boston Logan	2	21:1	0
Washington National	1	26:1	2
Dulles	4	39:1	0

*Note: Many of the displacements are for noise abatement.

Source of data: FAA Master Reco[illegible] 5010-1.

are listed in the AFD if the objects lie within the boundaries of Part 77 approach surfaces; however, descriptive data about the size or location of the object relative to the runway end or centerline are not reported. Since this type of information is collected under the Airport Safety Data Program, the FAA should publish the descriptive data about significant objects as an approach or departure planning aid for pilots.

The Safety Board also noted that the lighting of obstructions is not consistently reported in the AFD and that there is no information about changes to operational procedures which may be dictated by the presence of an obstruction within the Part 77 approach surface boundaries. Since applicants for a pilot's license are not tested for knowledge of information in Part 77 or regarding information pertaining to hazards or obstructions in any other aeronautical publications, the Board believes that incorporating some explanatory material in the AFD regarding this subject would be beneficial.

OTHER SAFETY CONSIDERATIONS

Navigational Aids

Because navigation equipment plays an important part in determining an airport's operational flexibility and because the reliability of navigational aids (NAVAID's) could have safety implications, the study team surveyed airways facility staff at all the study airports to learn about problem areas. All of the airports visited had some problems with their NAVAID's. Most of the problems were associated with the age of the NAVAID equipment. This was especially true of the tube-type instrument landing systems (ILS's). The FAA has an ongoing program to replace vacuum tube-type ILS's with solid-state equipment. At the end of fiscal year 1983, approximately two-thirds of the ILS's in the United States had been retrofitted, according to airways facility staff at FAA Headquarters.

There were five airports that, due to their geographical locations, experienced problems with their NAVAID's. These airports were Denver Stapleton, San Diego Lindbergh, New York La Guardia, Boston Logan, and Washington National. At Denver Stapleton, a water tower along the approach to runway 26L produces reflection of electronic signals. At San Diego Lindbergh, the natural and man-made obstructions east of the airport result in a steep approach to runway 27. New York La Guardia, Boston Logan, and Washington National have had problems with the operation of some NAVAID's on overwater approaches due to tidal or surface roughness effects, which may interfere with proper electronic signal reflection or cause the electronic beam location to shift relative to the runway as the water surface rises and falls. To correct this problem, the NAVAID must be moved to a location where signal reflection occurs on a fixed-plane surface.

Airways facility personnel at the above facilities said that many of the problems they had experienced with their NAVAID's could be lessened or alleviated with the installation of a microwave landing system (MLS). Boston Logan, Denver Stapleton, and Washington National are slated for MLS installations within the next 2 years. The U.S. Department of Transportation (DOT) has approved the procurement of all 1,250 MLS units called for in the National Airspace System Plan. The FAA has issued a request for proposals covering the acquisition of the first 172 units over a 5-year period. The MLS uses scanning-beam techniques to provide precision guidance coverage over a much larger azimuth and elevation angle range than the present ILS, which has been in service around the world since the late 1940's. This coverage will greatly increase operational flexibility at airports by offering a wide range of final approach paths, including curved approaches good for locations such as runway 18 at Washington National. The equipment is also less sensitive to building and terrain interference and less vulnerable to environmental factors, since the MLS signal is radiated directly into space rather than reflected off a smooth ground plane as with an ILS. The National Airspace System Plan envisions all 1,250 MLS units in service at United States airports by the year 2,000.

The FAA has not had an active hiring program for the airways facility sector in several years. FAA Headquarters management believes that the hiring and training of new personnel is unwarranted because the FAA's current Navaid Modernization Program will eliminate the need to have the present number of airways facility technical personnel. However, many airways facility personnel expressed concern over the FAA's ability to implement and complete this modernization program in a timely manner; they were especially concerned with their ability to adequately maintain the older NAVAID systems during the period of building, testing, and commissioning of the new systems. For example, Houston Hobby airway facility personnel said that a majority of their technicians would be eligible to retire within the next 5 to 8 years. Only three of their radar technicians will remain in 6 years, and it takes at least 3 years to fully train a radar technician. Boston Logan airway facility personnel said that about 46 percent of their technicians would be eligible for retirement by 1989. Boston Logan currently has no trainees, and it reported that 3 to 4 years are needed to bring a "new hire" up to "journeyman" level. Washington National airway facility personnel said that 11 out of 28 technicians would be eligible to retire within the next 5 years.

Noise Abatement Procedures

All of the 14 study airports had some form of noise control plan in effect to reduce the impact of aircraft noise on the surrounding communities. These plans ranged from simple aircraft pattern adjustments to more restrictive procedures including altitude restrictions, runway rotational programs, restrictions on type aircraft, operating curfews, and elaborate noise monitoring and enforcement programs. Although there appears to have been no accidents attributable to the operating procedures used for noise abatement, the modified approach and takeoff procedures often involve smaller safety margins than the procedure which would have been used otherwise. For example, noise-sensitive airports favor high-altitude, low-drag, minimum-thrust approaches which provide noise relief for communities beneath approach paths. However, this type of operation detracts from stabilized approaches and can lead to high approach speeds, high rates of descent, and idle thrust levels at a high-drag configuration during landing transition. An unsuccessful transition can result in a hard landing, veer off, or overrun. Adherence to noise abatement departure profiles also require steep climbs which may detract from the flightcrew's ability to look over the glareshield for other traffic in the terminal area. Furthermore, noise abatement procedures complicate air traffic operations in the terminal area, and therefore flight operations are not conducted as efficiently as they could be. Operations at Los Angeles International, Chicago O'Hare, Boston Logan, and Kennedy International are routed over water as much as possible because of noise and traffic congestion considerations. Improved engine technology and the ingenuity and professionalism of flightcrews and air traffic control personnel have compensated to some degree for the loss in efficiency due to noise abatement concerns.

CONCLUSIONS

1. Decreases in the rates of airport-related accidents since the inception of the Federal Aviation Administration's airport certification program in 1972 indicate a measurable improvement in airport safety.

2. The decreases in the rates of airport-related accidents probably involve several factors in addition to the airport certification program, including technological improvements in aircraft systems, upgraded navigational facilities, improved operational training, and increased awareness of the operational hazards in the terminal area.

3. The airport certification program does in fact assure that airports comply with Federal regulations and through periodic inspection provides for an evaluation of the effectiveness of airport management in conducting day-to-day operations safely.

4. The regulations in 14 CFR Part 139 and Federal Aviation Administration guidance material allow certification inspectors, who have varying experience, to make subjective evaluations of an airport's operations, which leads to the acceptance of nonstandard measures as demonstrating satisfactory compliance with the regulations.

5. Federal Aviation Administration inspection records of physical facilities and conditions at the 14 airports studied by the Safety Board generally were corroborated by the observations of the Board's study team.

6. At the study airports, the compliance measures accepted by the Federal Aviation Administration for bird hazard reduction, snow removal, and selfinspection programs differed significantly, but the measures appeared to be effective and appropriate.

7. The vagueness of certain Federal Aviation Administration compliance criteria and regional variations on the application of compliance criteria have resulted in some study airports having far better methods than others of controlling ground vehicle operation, fuel dispensing and storage, runway surface condition assessment, and public protection and animal control.

8. In general, certification inspectors tended to emphasize those areas in certification rules with which they were most familiar based on their prior professional experience or formal training.

9. Because of limited funds, most certification inspectors had limited opportunities to exchange work-related information, observe work methods of colleagues, and participate in meetings to discuss problems with airport managers.

10. The inspection workload of certification inspectors varied widely among the regional offices of the Federal Aviation Administration. Large inspection workloads in the Great Lakes and Southern regions resulted in less opportunity for inspectors in these regions to participate in information exchanges regarding airport operations.

11. Regional certification program administration lacks standardization.

12. Regionally dispersed technical expertise is not used fully in the airport certification program.

13. Most Federal Aviation Administration certification inspectors did not have experience with or knowledge of fuel storage facility operations and were unable to inspect fueling operations effectively.

14. The Federal Aviation Administration needs a standardized program to train certification inspectors to evaluate fuel dispensing procedures and storage facilities.

15. Many airports do not have staff personnel who are knowledgeable in the handling and storing of aircraft fuel.

16. Screening and training of prospective fuel service facility employees varies substantially in thoroughness and scope among airports.

17. The Federal Aviation Administration has the legal authority to establish training and proficiency standards for fueling personnel, and many airport managers believe that the FAA should license fueling personnel.

18. The fueling vehicle condition checklists reviewed by the Safety Board study team did not provide the certification inspectors specific guidelines to be used in deciding whether to accept or reject a vehicle being inspected.

19. Construction on airports and in surrounding areas has reduced or eliminated physical separation between fuel storage facilities and developed areas.

20. Older safety and warning devices at many fuel storage facilities were not accurate or reliable.

21. Nearly all study airports voluntarily met the water and extinguishing agent guidelines of the National Fire Protection Association and the International Civil Aviation Organization, which far exceed the minimum requirements specified by the Federal Aviation Administration in 14 CFR Part 139.

22. All nine study airports which had no structural firefighting responsibilities had far more crash-fire-rescue staff per shift than required by 14 CFR Part 139.

23. Observations of study airports indicated that 14 CFR Part 139 minimum requirements for extinguishing agent and staffing may be unrealistically low for index C, D, and E airports.

24. Certification inspectors have not been provided minimum standard criteria by which to evaluate the adequacy of many types of crash-fire-rescue training activities conducted at airports.

25. The Federal Aviation Administration's guidelines for protective clothing for firefighting operations do not preclude the use of less effective types of clothing, and there are no criteria for judging the relative merits of the acceptable types of protective suits.

26. There is no requirement for airports to exercise emergency plans periodically.

27. Most of the proposals for changes to 14 CFR Part 139 presented at the Federal Aviation Administration's public meeting of July 14, 1983, were positive and responsive to past Safety Board recommendations.

28. The Federal Aviation Administration's proposal to reduce crash-fire-rescue requirements at index A and B airports could result in situations where large jet aircraft operations are conducted with little or no crash-fire-rescue protection at these airports.

29. There is no regulation which contains a uniform standard for the marking, lighting, and guidance signs on runways, thresholds, and taxiways of airports.

30. The rate of accidents involving encroachment of aircraft on areas adjacent to runways for the postcertification period 1973 through 1981 has decreased by more than 50 percent from the rate for the precertification period 1964 through 1972.

31. The most destructive encroachment accidents between 1964 and 1981 usually involved aircraft striking objects in areas adjoining runways.

32. At transport airports that have become physically constrained, safety areas at the ends of runways were nonexistent or marginal in comparison to design guidelines of the Federal Aviation Administration's Advisory Circular 150/5335-4, but the safety areas alongside the runways were adequate.

33. Some extended safety areas at the ends of runways on less constrained airports were smaller than recommended in design guidelines of the Federal Aviation Administration's Advisory Circular 150/5335-4, but longer runways at these airports gave more overrun protection. The safety areas alongside the runways were adequate.

34. The extension of safety area dimensions at the ends of runways at smaller airports surrounded by commercial development would not be economically feasible in most cases.

35. The soft-ground aircraft arresting concept may be an economical means of safely improving stopping capability in dimensionally limited safety areas or on runways bounded by water.

36. Most of the structures located within the runway safety areas are mounted on frangible supports. Some structures which must remain in safety areas to serve an operational function are not frangible, and as yet experts have not been able to design submerged supporting structures which satisfy low impact resistance criteria and still withstand forces caused by immersion in water.

37. There is no Federal regulation restricting the construction of off-airport structures that obstruct the nation's navigable airspace. The Federal Aviation Administration has been successful in limiting the number of obstructions by negotiation.

38. Past Safety Recommendations made by the Safety Board based on several accident investigations indicate that obstacles which pose potential hazards to aircraft operations probably are more prevalent at noncertificated utility airports than at transport airports, and that they are less precisely described in aeronautical publications.

39. Measures to protect the airspace around United States airports for aircraft operations recommended by the President's Airport Commission in 1952 have not been implemented.

40. Many navigational aid problems at the study airports were related to difficulty in maintaining aging vacuum tube-type instrument landing systems or difficulty in maintaining acceptable system tolerances due to reflective problems caused by man-made and topographical features.

41. During transition to new low-maintenance navigational systems, the operability of the remaining existing systems could be affected by projected reductions in airways facilities technical maintenance staff.

42. Although a noise abatement policy may be a reasonable approach to the problem of aircraft noise, the establishment of noise abatement procedures can adversely affect the efficiency of aircraft operations and could create safety hazards.

RECOMMENDATIONS

As a result of this safety study, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Amend 14 CFR 139.65, "Public Protection," to require safeguards against unauthorized entry of persons and inadvertent entry of large animals onto any airport operations area. (Class II, Priority Action) (A-84-21)

Revise FAA Order 5280.5, "Public Protection," to establish criteria for acceptable types of fencing and support structure and a policy for gate security for the air operations area at certificated airports. (Class II, Priority Action) (A-84-22)

Revise FAA Order 5280.5, "Ground Vehicles," to include specific criteria for determining the adequacy of ground vehicle control, such as the number of ground vehicle accidents each year, disciplinary actions taken in accident cases, the number of repeat offenders, and an annual accident rate. (Class II, Priority Action) (A-84-23)

Establish an airport directorate within the FAA, similar to aircraft certification directorates, having technical resources and authority to provide leadership for the airport certification program and consistent application of 14 CFR Part 139. (Class III, Longer-Term Action) (A-84-24)

Certificate fueling personnel at certificated airports. (Class III, Longer-Term Action) (A-84-25)

Establish designated fueler certification examiners to ensure a uniform standard for fueling training, knowledge, and competence at certificated airports. (Class III, Longer-Term Action) (A-84-26)

As an interim measure until a program for certificating fueling personnel can be established, revise the compliance criteria applicable to certificated airports in FAA Order 5280.5, "Handling and Storage of Hazardous Material," to contain specific standards for initial and recurrent training of fueling personnel, which address methods of assuring fuel quality, fire prevention, vehicle inspection and operation, proper fueling techniques, and knowledge of airport operating rules. (Class II, Priority Action) (A-84-27)

Revise the compliance criteria in FAA Order 5280.5, "Handling and Storage of Hazardous Material," to incorporate detailed procedures for fuel storage area inspections and specific facility acceptability criteria. (Class II, Priority Action) (A-84-28)

Require certificated airports to include fuel storage and dispensing facilities in the selfinspection program prescribed in 14 CFR 139.57 and 139.91 and specify the items, including tank overfill warning devices, which must be checked and approved by airport inspection staff. (Class II, Priority Action) (A-84-29)

Adopt design and construction standards for fuel storage area site selection and safety devices at airport fuel storage facilities to be applied uniformly to new airports receiving Federal funds or to currently certificated airports when storage facilities are relocated. (Class III, Longer-Term Action) (A-84-30)

Revise 14 CFR 139.49(b) crash-fire-rescue index requirements for water and extinguishing agents to include the recommendations for extinguishing agents specified by the International Civil Aviation Organization or as published in FAA Advisory Circular 150/5210-6B. (Class II, Priority Action) (A-84-31)

Revise 14 CFR 139.49(h) to require a minimum of two firefighters per vehicle and to specifically define minimum standards for training of crash-fire-rescue personnel. (Class II, Priority Action) (A-84-32)

Revise FAA Order 5280.5, "Fire Fighting and Rescue," to prescribe equipment equal to or better than the proximity suit with lining that is recommended in paragraph 154d, as acceptable for aircraft firefighting and to contain standards by which the adequacy of this protective clothing can be determined, for the most extreme exposure conditions which can be safely encountered. (Class II, Priority Action) (A-84-33)

Amend 14 CFR 139.55 to require a full-scale demonstration of certificated airport emergency plans and procedures at least once every 2 years, and to require an annual validation of notification arrangements and coordination agreements with participating parties. (Class II, Priority Action) (A-84-34)

Incorporate in any 14 CFR Part 139 rulemaking proposal calling for a reduction in crash-fire-rescue capability at index A and B airports a list of affected airports, a list of types and schedules of air carrier aircraft serving these airports, and a description of the effect of such a reduction on the firefighting posture of the airports. (Class II, Priority Action) (A-84-35)

Initiate research and development activities to establish the feasibility of submerged low-impact resistance support structures for airport facilities, and promulgate a design standard, if such structures are found to be practical. (Class II, Priority Action) (A-84-36)

Initiate research and development activities to establish the feasibility of soft-ground aircraft arresting systems and promulgate a design standard, if the systems are found to be practical. (Class III, Longer-Term Action) (A-84-37)

Where elimination of obstructions that have a significant adverse effect on aircraft operation at public-use airports is not feasible, publish detailed data on the location of the obstructions and corresponding operational procedures or flight restrictions in the Airport/Facility Directory. (Class II, Priority Action) (A-84-38)

Seek statutory authority to prescribe civil penalties for sponsors of proposed construction who fail to comply with the notification requirements of Subpart B of 14 CFR Part 77. (Class II, Priority Action) (A-84-39)

Incorporate into pilot training programs and appropriate aeronautical publications sufficient information on the Airport Safety Data Program to familiarize airmen with the criteria in 14 CFR Part 77 used to determine whether an object is an obstruction to air navigation that might adversely affect aircraft operations. (Class III, Longer-Term Action) (A-84-40)

Provide continuing maintenance services for existing navigational facilities during the period of transition to the new generation of equipment. (Class II, Priority Action) (A-84-41)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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April 11, 1984

APPENDIXES

APPENDIX A

STUDY AIRPORT CRITERIA AND ACCIDENT STATISTICS

Table L--Airport Selection Rationale

Airport	Regional coverage	Reasons for selection
Washington National	Eastern	Early design standard, physical limitations, limited safety areas, high incident rate, limited number of ILS runways
Dulles International	Eastern	Modern design standards
Kennedy International	Eastern	Modern design standards, high incident rate, bird hazard and control methods, limited safety area
New York La Guardia	Eastern	Early design standards, physical limitations, limited safety areas, bird hazard, short runway used by wide-bodied aircraft
Los Angeles International	Western Pacific	Modern design standards, bird hazard
Burbank-Glendale-Pasadena	Western Pacific	Early design standards, physical limitations, limited safety areas, limited number of ILS runways, recent runway reconstruction, terminal considered an obstruction by Part 77 criteria
Houston Intercontinental	Southwest	Modern design standards, high incident rate, recent runway extension, bird hazard
Houston Hobby	Southwest	Early design standards, high incident rate, physical limitations, recent runway reconstruction, bird hazard, fueling problems
Chicago O'Hare	Great Lakes	Modern design standards, moderate incident rate, recent runway reconstruction
Chicago Midway	Great Lakes	Early design standards, physical limitations, short runway, limited safety areas

Airport	Regional coverage	Reasons for selection
San Diego Lindbergh	Western Pacific	Early design standards, physical limitations, limited number of ILS runways, limited safety area, recommended for inclusion by AAAE and ALPA
Denver Stapleton	Northwest Mountain	Limited safety area, recent runway extension, good firefighting training
Boston Logan	New England	Moderate incident rate, limited safety area, considering runway modification, recommended by AAAE and ALPA
Ft. Lauderdale-Hollywood	Southern	Recent runway extension, limited number of ILS runways, bird hazard, previous crash-fire-rescue problems in certification activity records

Table II.--Study Airport Size and Civil Aircraft Operations from FAA Master Record 5010-1

Airport	Acreage	No. and length of longest runway	Total No. operations	Air carrier operations
Ft. Lauderdale-Hollywood (FLL)	1,180	3 - 8,048	326,195	92,509
Kennedy International (JFK)	5,200	5 - 14,572	310,205	228,995
New York La Guardia (LGA)	640	3 - 7,000	293,445	203,880
Chicago O'Hare (ORD)	7,000	6 - 11,600	605,118	438,684
Chicago Midway (MDN)	640	4 - 6,519	212,691	29,373
Los Angeles International (LAX)	3,500	4 - 12,091	477,577	349,979
Burbank-Glendale-Pasadena (BUR)	435	2 - 6,902	176,208	27,563
San Diego Lindbergh (SAN)	480	2 - 9,400	134,096	59,591
Denver Stapleton (DEN)	4,600	5 - 12,000	485,695	316,664
Houston Intercontinental (IAH)	1,304	4 - 7,602	357,422	67,339
Houston Hobby (HOU)	7,200	4 - 12,001	336,789	187,439
Boston Logan (BOS)	2,384	4 - 10,001	310,755	193,405
Dulles International (IAD)	9,986	4 - 11,501	223,186	29,828
Washington National (DCA)	861	3 - 6,869	302,070	176,333

Table III.--Scope of Certification and Operation Rules in 14 CFR Part 139

Subpart C—Airport Operations Manual

139.31	Preparation and maintenance
139.33	Contents

Subpart D—Certification Eligibility: Airports Other Than Heliports

139.41	Eligibility requirements: general
139.43	Pavement areas
139.45	Safety areas
139.47	Marking and lighting runways, thresholds, and taxiways
139.49	Airport firefighting and rescue equipment and service
139.51	Handling and storing hazardous articles and materials
139.53	Traffic and wind direction indicators
139.55	Emergency plan
139.57	Selfinspection program
139.59	Ground vehicles
139.61	Obstructions
139.63	Protection of NAVAIDS
139.65	Public protection
139.67	Bird hazard reduction
139.69	Airport condition assessment and reporting
139.71	Identifying, marking, and reporting construction and other unserviceable areas

Subpart E—Operations

139.81	Operations rules: general
139.83	Pavement areas
139.85	Snow removal and positioning
139.87	Cleaning and replacing lighting items
139.89	Airport firefighting and rescue equipment and service
139.91	Selfinspection
139.93	Maintenance of approach and other imaginary surfaces

Table IV.—Precertification and Postcertification Accident Data

Description	1964 Thru 1972	1973 Thru 1981
Total No. of Accidents in Data Base	47298	43301
No. of Air Carrier Accidents Occurring in U.S.*	1002	499
Percent of Total Accidents	2.12%	1.15%
No. per Million Air Carrier Operations	11.92	5.68
No. of Fatal Air Carrier Accidents Occurring in U.S.	95	41
Percent of Total Accidents	0.20%	0.09%
Percent of Air Carrier Accidents	9.48%	8.2%
No. per Million Air Carrier Operations**	1.13	0.47
No. of Airport-Related Accidents Occurring in U.S.***	3236	3375
Percent of Total Accidents	6.84%	7.79%
No. per Million Operators	8.87	7.89
No. of Fatal Airport-Related Accidents Occurring in U.S.	67	88
Percent of Total Accidents	0.14%	0.20%
No. per Million Operations	0.184	0.21
No. of Air Carrier Airport-Related Accidents Occurring in U.S.	63	52
Percent of Total Accidents	0.13%	0.12%
No. per Million Air Carrier Operations	0.75	0.60
No. of Fatal Air Carrier Airport-Related Accidents Occurring in U.S.	1	3
Percent of Total Accidents	.002%	.006%
No. per Million Air Carrier Operations	.012	.034

* Including U.S. Territories and Possessions

** Total Operation Statistics Obtained from FAA Air Traffic Activity Reports

*** Accidents in Which Airport Facilities, Conditions or Personnel Were Cited as a Cause or Contributing Factor

Table V.—Yearly Rates of Airport-Related Accidents and Incidents

Year	No. of Airport-Related Accidents Per Million Operations**	No. of Airport Related Accidents That Involved Air Carrier (Part 121) Operators Per Million Operations
1964	5.3	0.94
1965	6.3	1.15
1966	7.7	0.85
1967	9.2	0.43
1968*	6.3	0.96
1979	6.5	0.56
1970	8.8	0.91
1971	7.9	0.51
1972	7.6	0.52
9 Year Rate	8.87	0.75
1973	11.9	0.81
1974	11.2	0.85
1975	7.6	1.19
1976	6.1	0.83
1977	5.0	0.82
1978	5.0	2.00
1979	4.8	0.19
1980	3.9	0.30
1981	5.4	0.42
9 Year Rate	7.89	0.60

* Definition of Substantial Damage Changed

** Accidents in Which Airport Facilities, Condition or Personnel Were Cited as a Cause or Contributing Factor
Total Operations and Air Carrier Operations Statistics Obtained from FAA Air Traffic Activity Reports.

Table VI—Precertification Accident Data at Study Airports

Period	Description	SAN	FLL	DEN	BUR	LAX	HOU	IAH	BOS	JFK	LGA	ORD	MDW	IAD	DCA
64-72	No. of Accidents	12	54	75	26	35	43	2	47	91	40	52	39	17	32
	–Percent of All Accidents *	.025	.11	.16	.05	.07	.09	.004	.10	.19	.08	.11	.08	.04	.07
	–No. Per Million Operations **	7.02	15.0	22.6	13.3	8.1	18.6	3.01	37.2	24.4	14.2	9.4	19.5	9.96	11.0
	No. of Fatal Accidents	4	2	3	2	1	3	0	4	3	1	6	2	1	1
	–Percent of All Accidents	.008	.004	.006	.004	.002	.006	0	.008	.006	.002	.013	.004	.002	.002
	–No. Per Million Operations	2.3	.6	.9	1.0	.23	1.3	0	3.2	.81	.36	1.09	1.0	.59	0.34
	No. of Airport-Related Accidents	0	3	4	0	2	2	0	6	9	3	3	1	0	0
	–Percent of All Accidents	0	.006	.008	0	.004	.004	0	.013	.02	.006	.006	.002	0	0
	–No. Per Million Operations	0	0.83	1.2	0	0.46	0.87	0	4.75	2.4	1.08	0.54	.50	0	0
	No. of Fatal Airport-Related Accidents	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Total Number Accidents 1964-1972: 47298

** Operations Statistics Obtained from FAA Air Traffic Activity Reports

Table VII.—Postcertification Accident Data at Study Airports

Period	Description	Airports SAN	FLL	DEN	BUR	LAX	HOU	IAH	BOS	JFK	LGA	ORD	MDW	IAD	DCA
73-81	No. of Accidents	7	27	25	17	21	20	5	24	37	14	43	17	9	14
	–Percent of All Accidents *	.02	.06	.06	.04	.05	.05	.011	.06	.09	.03	.10	.04	.02	.03
	–No. Per Million Operations **	4.2	9.5	6.35	8.01	4.66	7.16	2.3	8.3	13.8	4.5	6.74	10.00	5.5	4.62
	No. of Fatal Accidents	0	2	1	1	2	3	1	3	4	3	1	2	0	0
	–Percent of All Accidents	0	.005	.002	.002	.005	.007	.002	.007	.009	.007	.002	.005	.0	.0
	–No. Per Million Operations	0	.71	.25	.47	.44	1.07	.462	1.04	1.5	0.97	.16	1.2	0	0
	No. of Airport-Related Accidents	1	3	0	2	2	0	0	6	8	3	5	3	0	2
	–Percent of All Accidents	.002	.007	0	.005	.005	0	0	.014	.018	.007	.011	.007	0	.005
	–No. Per Million Operations	.6	1.06	0	.94	0	0	0	2.08	2.98	0.97	.78	1.77	0	0.66
	No. of Fatal Airport-Related Accidents	0	0	0	0	1	0	0	0	0	1	0	0	0	0
	–Percent of All Accidents	0	0	0	0	.002	0	0	0	0	.002	0	0	0	0

* Total Number Accidents 1973-1981: 43301

** Operations Statistics Obtained from FAA Air Traffic Activity Reports

Table VIII.—Air Carrier Accident Data at Study Airports (Precertification)

Period	Description	Airports SAN	FLL	DEN	BUR	LAX	HOU	IAH	BOS	JFK	LGA	ORD	MDW	IAD	DCA
64-72	No. of Air Carrier (Part 121) Accidents Accidents *	0	1	9	1	15	2	2	14	53	11	26	1	7	12
	–Percent of All Accidents	0	.002	.02	.002	.03	.004	.004	.03	.11	.02	.05	.002	.015	.025
	–No. Per Million Air Carrier Operations **	0	3.02	6.9	4.1	4.5	3.7	4.0	8.2	20.8	5.6	5.3	4.1	15.4	6.0
	No. of Fatal Air Carrier (121) Accidents	0	0	1	0	0	0	0	0	3	0	4	0	0	0
	–Percent of All Accidents	0	0	.002	0	0	0	0		.006	0	.008	0	0	0
	–No. Per Million Air Carrier Operations	0	0	0.8	0	0	0	0	0	1.2	0	0.8	0	0	0
	No. of Airport-Related Air Carrier (121) Accidents	0	0	2	0	0	1	0	3	4	0	2	0	0	0
	No. of Fatal Airport-Related Air Carrier Accidents	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Total Number Accidents 1964-1972: 47298

** Operations Statistics Obtained from FAA Air Traffic Activity Reports

Table IX.—Air Carrier Accident Data at Study Airports (Postcertification)

Period	Description	Airports SAN	FLL	DEN	BUR	LAX	HOU	IAH	BOS	JFK	LGA	ORD	MDW	IAD	DCA
73-81	No. of Air Carrier (Part 121) Accidents	0	1	8	1	9	0	1	5	21	6	16	1	2	7
	–Percent of All Accidents *	0	.002	.02	.002	.021	0	.002	.011	.05	.014	.04	.002	.005	.02
	–No. Per Million Air Carrier Operations **	0	1.4	3.6	3.6	2.7	0	0.8	2.7	8.6	2.6	3.12	9.7	4.3	3.8
	No. of Fatal Air Carrier (121) Accidents	0	0	0	0	1	0	0	2	2	0	1	0	0	0
	–Percent of All Accidents	0	0	0	0	.002	0	0	.005	.005	0	.002	0	0	0
	–No. Per Million Air Carrier Operations	0	0	0	0	0.3	0	0	1.1	0.8	0	—	0	0	0
	No. of Airport-Related Air Carrier (121) Accidents	0	0	0	0	1	0	0	0	5	0	1	0	0	1
	No. of Fatal Airport-Related Air Carrier Accidents	0	0	0	0	1	0	0	0	0	0	0	0	0	0

* Total Number Accidents 1973-1981: 43301

** Operations Statistics Obtained from FAA Air Traffic Activity Reports

Table X.—Regional Workload Indicators Based on Certification Activity Reports May 1982 – May 1983

Region	Number of Certificated Airports Per Inspector	No. of Fully Certificated Airports Per Inspector	No. of Limited Certificate Airports Per Inspector	% of Airport Division Staff Assigned to Certification Program Full Time	% of Regional Total Annual Inspections (For 7 Study Regions)	% of Regional Total Non-Certification Inspection Activity	% of Regional Total of Violation, Legal Action or or Warning
Southern	51	44	7	3.2	16.8	6.1	10
Eastern	25.7	18	7.7	6.8	12.5	9.4	10
Great Lakes	63	51.5	11.5	3.3	22.8	1.1	20
Northwest Mountain	25.7	21	4.7	6	15.2	2.2	0
Western Pacific	23.3	20	3.3	6.7	12	2.5	35
Southwest	15	13.2	1.8	10	10.9	40.1	20
New England	32	8	24	8.8	9.8	38.6	5

Table XI.—Undershoot Accidents Involving Air Carrier (Part 121) Operators

Year	Number of Accidents	% of Total Which Are Fatal	No. Accidents Per Million Air Carrier Operations (for year)*	% of Accidents On IFR Approach	% Occurring On Airport or < ¼ Mi From Nearest Runway	% Involving Minor or No Damage	% Involving Precipitation
1964	6	0	0.81				
1965	5	20	0.64				
1966	6	0	0.73				
1967	4	25	0.43				
1968**	7 (6)***	29	0.58				
1969	1	0	0.09				
1970	3 (2)	0	0.19				
1971	0	0	0				
1972							
9 Year Period	32 (30)	6.25%	0.36	34%	88%	31%	28%
1973	3	0	0.30				
1974	2	50%	0.22				
1975	4	25	0.43				
1976	0	0	0				
1977	1	0	0.10				
1978	0	0	0				
1979	1	0	0.10				
1980	2 (1)	0	0.10				
1981	0	0	0				
9 Year Period	13 (12)	15.4%	0.14	38%	77%	31%	46%

* Rate Based on Accidents Occurring in U.S. Including Territories and Possessions
** Definition of Substantial Damage Changed
*** Accidents Occurring in U.S. Including Territories and Possessions

Table XII.—Overshoot Accidents Involving Air Carrier (Part 121) Operators

Year	Number of Accidents	% of Total Which Are Fatal	No. Accidents Per Million Air Carrier Operations (for year)*	% Occurring On Landing	% Occurring On Airport or < ¼ Mi From Nearest Runway	% Involving Minor or No Damage	% Involving Precipitation
1964	6	0	0.81				
1965	3	0	0.38				
1966	3	0	0.37				
1967	3	0	0.32				
1968**	4 (3)***	0	0.29				
1969	5	0	0.46				
1970	6	0	0.58				
1971	3 (2)	0	0.20				
1972	0	0	0				
9 Year Period	33 (31)	0	0.37	97%	100%	52%	45%
1973	4	0	0.40				
1974	0	0	0				
1975	3	0	0.33				
1976	5	40	0.52				
1977	1	0	0.10				
1978	1	0	0.10				
1979	1	0	0.10				
1980	1	0	0.10				
1981	0	0	0				
9 Year Period	16	12.5%	0.18	100%	100%	31%	56%

* Rate Based on Accidents in U.S. Territories and Possessions

** Definition of Substantial Damage Changed

*** Accidents Occurring in U.S. Including Territories and Possessions

Table XIII.—Veer Off Accidents Involving Air Carrier (Part 121) Operators

Year	Number of Accidents	% of Total Which Are Fatal	No. Accidents Per Million Air Carrier Operations (for year)*	% Occurring On Landing	% Occurring On Airport or < ¼ Mi From Nearest Runway	% Involving Minor or No Damage	% Involving Precipitation
1964	11 (9)***	9.1	1.21				
1965	4	0	0.51				
1966	8	0	0.97				
1967	5	0	0.53				
1968**	6	0	0.58				
1969	5	0	0.46				
1970	6	0	0.58				
1971	9 (8)	0	0.82				
1972	0	0	0				
9 Year Period	54 (51)	1.86%	0.61	67%	100%	39%	35%
1973	3	0	0.30				
1974	2	0	0.22				
1975	2	0	0.22				
1976	2	0	0.21				
1977	3	0	0.31				
1978	2	0	0.20				
1979	4 (2)	0	0.19				
1980	2 (1)	0	0.10				
1981	1	0	0.11				
9 Year Period	21 (18)	0	0.21	86%	100%	52%	62%

* Rate Based on Accidents Occurring in U.S. Territories and Possessions
** Definition of Substantial Damage Changed
*** Accidents Occurring in U.S. Including Territories and Possessions

Table XIV.—Undershoot Accidents and Incidents Involving Air Carrier (Part 121) Operators Grouped by Runway Length (For Accidents Where Runway Data Were Available)

Year	< 5000	5000 to 5999	6000 to 6999	7000 to 7999	8000 to 8999	9000 to 9999	10000 +
1964	1	1	1	2	1	1	
1965	2	1		1			1
1966	1		1	2		1	
1967				1		1	1
1968	1	1		3			1
1969					1		
1970		1					
1971							
1972							
Total	5	4	2	9	2	3	3
1973				2			
1974				1		1	
1975		1		1	1		
1976							
1977	1						
1978							
1979		1					
1980	1						
1981							
Total	2	2		4	1	1	

NOTE Accident Rates for Each Runway Length Grouping Were Not Computed Because Data for Number of Air Carrier Operations Is Not Available by Length Groups

Table XV.—Overshoot Accidents and Incidents Involving Air Carrier (Part 121) Operators Grouped by Runway Length (For Accidents Where Runway Data Were Available)

Year	< 5000	5000 to 5999	6000 to 6999	7000 to 7999	8000 to 8999	9000 to 9999	10000 +
1964	1	3		1	1		
1965		1		2			
1966		1		1		1	
1967		1			1		1
1968		1		2			1
1969		1	2	1			1
1970		3	1		1	1	
1971				1	1		1
1972							
Total	1	11	3	8	4	2	4
1973			2	2			
1974							
1975		1			1		1
1976	1		1	2			1
1977			1				
1978		1					
1979	1						
1980		1					
1981							
Total	2	3	4	4	1		2

NOTE. Accident Rates for Each Runway Length Grouping Were Not Computed Because Data for Number of Air Carrier Operations Is Not Available by Length Groups.

Table XVI.—Veer Off Accidents and Incidents Involving Air Carrier (Part 121) Operators Grouped by Runway Length (For Accidents Where Runway Data Were Available)

Year	< 5000	5000 to 5999	6000 to 6999	7000 to 7999	8000 to 8999	9000 to 9999	10000 +
1964	2	1		2		1	
1965	2			1		1	
1966		3	1	1	1		2
1967	1		1				2
1968	1			1	1	1	2
1969	1	1			1		2
1970		1	1	1		1	2
1971	1				2	1	5
1972							
Total	8	6	3	6	5	5	15
1973	1				1		1
1974	1					1	
1975	1						1
1976							2
1977			1			1	1
1978			2				
1979			1				3
1980					1		
1981					1		
Total	3		4		2	2	8

NOTE: Accident Rates for Each Runway Length Grouping Were Not Computed Because Data for Number of Air Carrier Operations Is Not Available by Length Groups.

Table XVII—Undershoot, Overshoot, or Veer Off Accidents
In Which Aircraft Was Destroyed
(Based on Air Carrier (Part 121) Operator Accident Data)

Year	Type of Accident	Precipitation Present	Runway Length	Make and Model Aircraft	Consequence
64	Veer Off	None	Not Reported	B707	Not Reported
65	Undershoot	None	10000	B727	Not Reported
67	Undershoot	Snow	9500	CV880	Hit Trees
68	Undershoot	None	4700	M404	Gear Collapsed
68	Undershoot	None	5600	FH227	Hit Trees
68	Undershoot	None	Not Reported	B707	Hit Ground
70	Undershoot	Rain	Not Reported	CV990	Struck Approach Lights
73	Undershoot	Thunderstorm	7400	DC-9	Not Reported
74	Undershoot	Rain	9000	B707	Hit Trees
75	Undershoot	Thunderstorm	8400	B727	Struck Approach Lights
76	Overshoot	None	6000	L188	Gear Collapsed
76	Overshoot	Snow	7500	B727	Hit Ditches
76	Overshoot	None	4658	B727	Hit Building
79	Undershoot	None	5000	L188	Not Reported
80	Undershoot	Rain Showers	4820	B727	Gear Collapsed

Table XVIII.—Accidents and Incidents Involving Air Carrier (Part 121) Operators Grouped by Type of Airplane and Runway Length 1964 – 1981 (For Accidents Where Runway Data Were Available)

Overshoots	< 5000	5000 To 5999	6000 To 6999	7000 To 7999	8000 To 8999	9000 +
Narrow-Bodied 2 or 3 Engine Jet (737, 727, DC-9, BAC1-11)	1	6	7	6	4	3
Narrow-Bodied 4 Engine Jet (707, DC-8, CV 880)			1	3	3	3
Wide-Bodied Jet (L1011, DC-10, 747)					3	3
Undershoots						
Narrow-Bodied 2 or 3 Engine Jet (737, 727, DC-9, BAC1-11)	1	1		5	4	3
Narrow-Bodied 4 Engine Jet (707, DC-8, CU 880)			1	4	1	4
Wide-Bodied Jet (L1011, DC-10, 747)						1

Note: Exposure Data by Runway Length Not Available

Table XIX.—Large Air Traffic Hubs* for Calendar Year 1981 Based on Civil Aeronautics Board Airport Activity Statistics For Certificated Route Air Carriers

Community	*(Airport Name)*	*% of Enplanements*
Atlanta, Georgia	(William B. Hartsfield Intl)	7.03
Boston, Massachusetts	(Logan International)	2.49
Chicago, Illinois	(Midway)	0.19
	(O'Hare International)	6.16
	Community Total	6.35
Dallas-Fort Worth, Texas	(Love Field)	0.93
	(Dallas-Ft. Worth Regional)	4.30
	Community Total	5.23
Denver, Colorado	(Stapleton International)	3.92
Detroit & Ann Arbor, Michigan	(Detroit City)	0.01
	(Detroit Metropolitan Wayne City)	1.77
	Community Total	1.73
Honolulu, Oahu, Hawaii	(Honolulu International)	2.04
Houston, Texas	(Houston Intercontinental)	2.01
	(William P. Hobby)	0.80
	Community Total	2.81
Las Vegas, Nevada	(McCarran Intl)	1.59
Los Angeles/Burbank/Lng. Bch., CA	(Hollywood-Burbank)	0.35
	(Long Beach)	0.02
	(Los Angeles International)	5.11
	(Orange County)	0.44
	Community Total	5.92
Miami/Ft. Lauderdale, Florida	(Ft. Lauderdale-Hollywood Intl)	1.01
	(Miami International)	2.75
	Community Total	3.76
Minneapolis/St. Paul, Minnesota	(Minneapolis/St. Paul Intl)	1.70
Newark, New Jersey	(Newark)	1.70
New Orleans, Louisiana	(International/Moisant Field)	1.10
New York, New York	(John F. Kennedy Intl)	3.09
	(La Guardia)	3.18
	Community Total	6.27
Orlando, Florida	(Orlando Intl)	1.07
Philadelphia, PA/Camden, NJ	(International)	1.34
Phoenix, Arizona	(Phoenix Sky Harbor Intl)	1.27
Pittsburgh, PA/Wheeling, WVA	(Greater Pittsburgh)	1.57
St. Louis, Missouri	(Lambert-St. Louis Muni)	1.92
San Francisco/Oakland, CA	(Oakland Metropolitan Intl)	0.33
	(San Francisco Intl)	3.28
	Community Total	3.61
Seattle/Tacoma, Washington	(Boeing Field Intl)	0.00
	(Seattle-Tacoma International)	1.61
	Community Total	1.61
Tampa/St. Ptsbg/Clwtr & Lkland, FL	(Tampa International)	1.19
Washington, Dist. of Col.	(Dulles International)	0.36
	(Washington National)	2.37
	Community Total	2.73

* Large Hub is a community which accounted for at least one percent of the total enplaned revenue passengers.

APPENDIX B

CERTIFICATION PROGRAM VIEWS: FAA REGIONAL MANAGEMENT, AIRPORT MANAGEMENT, AND IDENTIFICATION AUDITS

FAA Regional Management Viewpoint

Some changes to 14 CFR Part 139 proposed by regional staff included:

- o Reference Advisory Circulars in 14 CFR Part 139 to provide specific guidance for regulatory compliance.
- o Reduce the crash-fire-rescue burden on smaller airports (favored in four regions); however, one inspector proposed user-funded crash-fire-rescue with indexing based only on length of aircraft.
- o Develop friction measurement standards.
- o Establish more specific policies regarding responsibility for the handling and storage of fuel at airports; at least one inspector favored placing the fueling surveillance responsibility with the air carriers.
- o Change the runway approach area obstruction criteria incorporated in 14 CFR Part 139 from the design criteria in 14 CFR Part 77 to the operational criteria in Terminal Instrument Procedures (TERPS).
- o Establish time limits on waivers granted under 14 CFR Part 139 and require a periodic review of the waived condition, or a specific reference to the waived item or condition in the airport operation manual indicating noncompliance with the rule.
- o Establish more specific requirements for daily inspections and airport manuals at limited certificate airports.
- o Establish a requirement for aircraft arresting barriers at physically limited airports.

Some regional activities of particular interest were noted during the visits of the Safety Board study team. One region had issued an airport safety publication which had widespread circulation and acceptance among airport operators; three regions had sponsored symposiums on topics of current interest to airport operators within the region. One regional inspector had established written guidelines for compliance with 14 CFR Part 139 which had been distributed to certificated airports in the region.

Regional staff members also were asked to characterize their relationship with the FAA Headquarters' Safety and Compliance Division. Five regions indicated that a cordial relationship existed in which headquarters provided useful guidance and information to the region; however, two regions indicated that no assistance was needed from headquarters to administer the certification program.

Airport Management Viewpoint

As in the case of FAA regional airport division managers, study airport management personnel were asked to assess the airport certification program. Beneficial aspects of the certification program as viewed by management personnel at the study airports included:

- Provides a degree of consistency and standardization among airports in safety-related aspects of airport operations and airside facilities.
- Provides lower passenger volume airports the needed leverage to obtain funds for safety-related improvements.
- Raises the level of awareness of airport management to potential problems and provides an objective review of airport facilities and operations by the FAA.
- Documents requirements leading to a more systematic approach to airport operations.

Some of the following difficulties and problems were articulated. As indicated in the views presented below, some disagreement exists regarding 14 CFR Part 139 and how it should be implemented:

- Application of 14 CFR Part 139 was not consistent from region to region because regulatory compliance interpretation varies.
- Annual inspection findings were not always consistent from year to year.
- Snow removal and crash-fire-rescue requirements were too vague.
- Airport operators should not be held responsible by 14 CFR Part 139 for surveillance of functions that they do not control, such as aircraft fuel storage and handling.
- Some requirements of 14 CFR Part 139 were too restrictive. For example, the obstruction criteria now incorporated in 14 CFR Part 77 requirements should be replaced by TERPS criteria and crash-fire-rescue requirements should be relaxed because of a low benefit-to-cost ratio.
- Some requirements of 14 CFR Part 139, such as grid maps and 3-inch-high pavement lips, are unrealistic and can be used as "nuisance" inspection findings by the FAA.
- Airport operators need clarification of the regulatory requirement of 14 CFR Part 139 regarding fuel storage and handling in order to deal with airport tenants supplying fuel.
- The methods which the FAA considers acceptable for demonstrating compliance with certification regulations should be flexible enough to account for significant geographical and demographical differences which affect airports.

Identification Audits Findings

The FAA's airport certification program was audited by the General Accounting Office (GAO) in 1975, 36/ and program audits at the regional level were documented in U.S. Department of Transportation (DOT) memoranda in 1979. 37/ The GAO audit was performed primarily in FAA's Eastern Region; the 1979 DOT audit covered the Northwest and Western Regions. The GAO report credited the certification program with having produced safety enhancement in crash-fire-rescue capability and control of obstructions. However, the report also cited some program weaknesses in 1975. For example, the GAO criticized the FAA for:

- The lack of a standard for measuring runway slipperiness because methods for doing so had not been selected.
- The writing of standards containing generalities without developing enforcement criteria.
- The practice of issuing limited certificates to airports serving unscheduled air carriers or restricted to operations with small aircraft based on an inspector's determination that the airport is adequately equipped to conduct a safe operation without having to meet the requirements of 14 CFR Part 139.

The Safety Board found that many of the discrepancies cited in the DOT regional audits had been or were being corrected in the regions visited by the study team. Two conditions were cited in the 1979 DOT audits which the Safety Board also observed in some regions:

- Failure of immediate supervisors to accompany certification inspectors on assignment as a means of evaluating performance.
- The lack of a standard for evaluating crash-fire-rescue training programs.

36/ "Report to the Congress, Federal Aviation Administration's Airport Certification Program: Has It Resulted in Safe Airports?," RED-76-5, August 8, 1975.
37/ Memo to: Director, FAA, Northwest Region; From: Acting Assistant Inspector General for Auditing; Subject: Report of Audit of Airport Certification Program, FAA, Northwest Region, No. SE-FA-79-2.9, May 9, 1979. Memo to: Director, FAA, Northwest Region; From: Regional Audit Manager, San Francisco; Subject: Report of Audit of Airport Certification Program, Federal Aviation Administration, No. SE-FA-79-1.11, January 5, 1979.

APPENDIX C

AIRPORT SAFETY INFORMATION SUBMITTED BY THE AIR LINE PILOTS ASSOCIATION

January 24, 1984

Mr. Bernard S. Loeb, Chief
Safety Standards & Analysis Division
National Transportation Safety Board, SP-10
800 Independence Ave., S.W.
Washington, D.C. 20594

Dear Mr. Loeb:

In response to our meeting of January 10, 1984, where airport safety was discussed, we have enclosed information concerning the following topics: inadequacy of requirements of marking and lighting, lack of lighted windsocks near runway ends, inadequacy of FAR Part 77, proper fire house location to minimize CFR response, need for standby electrical power at airports, ALPA recommendations concerning FAR Part 139 changes, and the importance of runway overruns.

Airport Marking and Lighting

The FAA with the issuance of FAR Part 139, Certification and Operations; Land Airports Serving CAB-Certificated Air Carriers, sought to set standards for airports to ensure a minimum level of safety. As you know, the regulation is loosely worded to allow the airport operator the flexibility to interpret the regulation with reference to his own unique needs. The lack of requirements for airport marking and lighting has resulted in an absence of standardization which, during critical phases of flight, can lead to confusion and misinterpretation of the information by the pilots.

Our argument for a requirement for standardized lighting and marking is based on our experience as active airline pilots and the fact that standardization is the cornerstone of aviation safety. The importance of correct interpretation of information by the pilots cannot be overemphasized; especially during the highly dynamic exercise of piloting an aircraft. This is exactly the reason that Air Traffic Control (ATC) communications have been standardized, that aircraft flight instrumentation placement and format have been standardized, and that the navigation and approach charts have been standardized; all an effort to avoid misunderstanding. As we all know it is not always successful. We think that there is a great amount of confusion and misinformation caused by the non-uniformity of airport marking and lighting. The following examples of this problem come from ALPA's own internal safety deficiency reporting system, supplied by line pilots.

> "We have problems with the taxiway markings at Idaho Falls, Idaho (IDA). The taxiway markings are off color and difficult to see especially at night. The reflectors used to mark the taxiways are also very hard to see by the pilots and might as well not be there."

"On Saturday we landed on runway 8 at HOU (Houston) in CAT II conditions. We used the high speed turnoff to exit the ruway using the green - centerline lights as guidance. The visibility was very poor. The green lights led us back on the runway via the opposite high speed taxiway. The flight following us had already initiated a missed approach due to decreasing visibility. We were lucky he initiated the miss."

"When departing south ramp in low visibility at MCO (Orlando, FLA) it is possible to pass by the parallel taxiway and encrouch onto runway 36R-18L. This is caused by the larger than normal fillet as the taxiway intersects the runway and the fact that the taxi edge lights continue to curve through the fillet."

"On runway 22 at OAD, there is a problem with the high-speed exit centerline lights. One of these lights, possibly the 2nd or 3rd that is parallel to the runway before the beginning of the curve, stands out and gives the impression to an aircraft on final that an aircraft is on the runway."

All of the above statements were received in the past two months from line pilots and are representative of the problems that exists with marking and lighting. ALPA has long recognized these problems and has pressed for revisions with little or no response from the FAA and NTSB. (See Attachment 1 and 2 for representative ALPA statements). We are even more concerned with the inadequacy of these markings and lighting in CAT II and CAT III conditions. These types of operations are becoming more common and we see a corresponding increase of confusion and misinterpretation of the present marking and lighting. Attachment 3 contains brief summations of recent air carrier accidents where misinterpretation of airport marking and lighting may well prove to be a factor.

The source of the problem stems from the lack of requirements in FAR Part 139 (Attachment 4, Part 139.47) for standardization of these systems. Currently the FAA only advises the airport operator how these systems should be designed and implemented in the applicable advisory circulars; there is no requirement that the airport operator follow the recommendations. We think the FAA should accept the responsibility to set and enforce standards for airport marking and lighting at those airports which are certificated under Part 139.

We think the best way to accomplish this goal is as follows. First, the FAA must embark upon a research program to determine which of the visual aids need to be improved. The technology exits to develop a visual aids simulator which can reproduce any situation on the airport with respect to weather, lighting, marking, etc. This should be utilized in this research effort. Secondly, the FAA should incorporate these findings in practical tests at their research facility in Atlantic City, N.J. Finally, these findings should be implemented as required standards.

The NTSB certainly recognizes the significance of hazardous trend identification in accident prevention. We as line pilots in the field have seen these trends with airport marking and lighting and recognize their significance. In our opinion it is the responsibility of the NTSB and FAA to take steps to correct the problem before a catastrophic accident occurs.

Lighted Windsocks

ALPA has for many years advocated the usefulness of lighted windsocks at the approach end of all air carrier runways. The rational for this position is very simple; it provides pilots preparing for takeoff, and those on short final, real time information concerning wind direction, velocity, and the relative gust factor for that particular runway. The word particular is underlined because that is the key of our position.

At the beginning of scheduled air transportation, airports were small and an airplane taxiing for takeoff would always pass the windsock on its way to the runway. Viewing the windsock the pilot could see the wind direction, approximate velocity, and how "gusty" the wind was. All of this information was vital because the pilot had to plan his takeoff, prior to the beginning of his takeoff roll, to take all these factors into consideration. This is no less true today for the pilot of a B-747 than it was for the pilot of a DC-3. But today, an air carrier airport is likely to be 3 or more miles from end to end; obviously one windsock as now required will not be visible to all departing flights. The information that the windsock provides is important because current methods of wind reporting are not always real time. If a pilot receives his information from the ATIS (Automatic Terminal Information Service) there is a good chance that it may not be very recent. Also, the location of the wind observations may not be experiencing the same wind conditions as a runway two or three miles away.

For these reasons we see the placement of lighted windsocks at the end of air carrier runways to be very beneficial. This is the location that must be used if a windsock is to be utilized to its full potential. ALPA's recommendations concerning lighted windsocks are contained in Attachment 2. We recommended to the FAA that this requirement be made part of Part 139.

FAR Part 77 - Objects Affecting Navigable Airspace

This topic has generated considerable concern among the airspace users in this country with justifiable reason. The problem with the present regulation is threefold. First, the FAA has no power to enforce the regulation. If the sponsor of a proposal wants to build even though a determination of hazard is made by the FAA, he can do so; the regulation has no enforcement "teeth". Secondly, the regulation does not address the hazards of obstructions during departure, only on approach. There are numerous runways that have departure paths, especially turning departures, that have obstructions that pose serious hazards to airplanes using that departure. This is of special concern to this Association. Thirdly, the review and determination process varies greatly from FAA region to region. It appears that criteria is used during the review process other than that listed in the regulation. There seems to be a relationship between how influential the proposal sponsor is and the ultimate determination made by the FAA.

We have enclosed a sizeable amount of information supporting our concerns. Attachment 5 is a letter to then Administrator Bond which addresses these concerns signed by the presidents of 1[illegible] associations representing airspace users. Attachment 6 is a copy of an article that appeared in the Air Line Pilot Magazine addressing these concerns. Attachment 7 is a paper dealing with the problem of the lack of protection from obstructions during turning departures. It lists runways that do, or could have an obstruction problem due to the Part 77 review weakness. Attachment 8 is an ALPA response to FAA Draft Advisory Circular 150/5300-4 Change 7, Appendix 6, "Runway Clear Zones" which deals indirectly with obstruction clearance problems. Attachment 9 is a letter from FAA to ALPA stating a timetable of early 1981 for an NPRM dealing with Part 77. We have not heard or seen anything as of this date. Attachment 10 is a lengthy document outlining AOPA concerns over Part 77. Attachment 11 is ALPA's position on the issue of obstruction clearance as outlined in the ALPA Guide to Airport Standards (Attachment 12).

Reviewing this documentation will give you a good overview of the airspace users' concerns relative to Part 77. It will also give you an understanding of the uniformity of concerns among these users, the unified wish for revision and modification of the regulation, and the total lack of response to these issues by the FAA. This topic is unique because all the users agree changes are needed and the FAA consistently and aptly avoids dealing with it. It has always been our understanding that the FAA exists to serve the flying public. Their performance on this topic indicates otherwise.

We feel that the consistent procrastination of the FAA on this issue should warrant a closer inspection by the NTSB. If changes are not forthcoming, the now usable airspace surrounding airports will become more restricted which ultimately will reduce the safety of operations at these airports.

Fire House Location

The issue of fire house placement is tied directly to CFR response times. FAR Part 139.49 (e) 1 and 2 requires that the initial CFR unit be able to reach the midpoint of the farthest air carrier runway in three minutes with the rest of the CFR units arriving in four minutes. This is not adequate because most accidents do not occur in the middle of the runway. Additionally, if an aircraft is on fire, interior flashover normally occurs in 90 to 120 seconds. For CFR to be most useful it must arrive in this time period. For these reasons the minimum response times should be two minutes to the end of the farthest runway. In order to achieve this goal fire house location is of great importance. This is discussed further in Attachment 13 which is the ALPA Rescue & Fire Committee position #2.

Standby Electrical Power at Air Carrier Airports

Many airports have standby generators to provide essential airport power if the primary power grid fails. Many of the same airports have decommissioned their standby generators due to cost considerations. The potential impact of these actions can be demonstrated in the following example.

All airplanes, including air carriers, when flying in instrument meterological conditions (IMC) are required to carry enough fuel to fly to the original destination airport, then to a designated alternate airport, and then fly an additional 45 minutes at cruise. This requirement is designed to ensure that the airplane will not run out of fuel before it can find an airport which is not weathered in. In Colorado, Grand Junction is a popular alternate airport for Denver. This is because Grand Junction is on the western side of the Rocky Mountains while Denver is on the east side. Often in this part of the country, the east slope of the Rockies will become socked in, forcing all the flights enroute to Denver to divert to Grand Junction which is normally clear. Grand Junction, however, decommissioned its standby power system to save costs. This information is not normally made available to the pilots through aeronautical publications. When this was done there was no way to keep the airport open if the power failed (which it did recently).

The problem with standby power arises when a pilot elects to go to Grand Junction because Denver is socked in. If, when he arrives at Grand Junction the electrical power has failed and there is no standby power, he will have no airport lights, electronic approach guidance, etc. The nearest airport at that point will be Salt Lake City, approximately 50 minutes away, but the pilot might only have approximately 45 minutes of fuel left - the difference is obvious as is the potential for a catastrophic accident. We think that the FAA should take steps to ensure that this does not happen.

First, the FAA should require those airports with standby generators to keep them in operable condition. Second, the FAA should determine those areas where the problem outlined above could occur and ensure that enough airports are equipped with standby power to prevent the scenario above. AIP monies should be used to fund the purchase of this equipment. Finally, the FAA should make this information available through aeronautical publications to all pilots. If these steps were accomplished, it would eliminate the potential for the above scenario.

<u>ALPA Recommendations - Part 139 Revisions</u>

The FAA is in the process of reviewing FAR Part 139 for future revision. ALPA has encouraged revision to Part 139 for many years. Attachment 14 is a complete listing of ALPA recommended changes to FAR Part 139. This was sent to Associate Administrator Bill Shea in November of 1982. Attachments 15 and 16 are internal memos dealing with industry meetings concerning Part 139.

<u>Runway Safety Areas</u>

The value of having runway safety areas is a concept which has gained wide acceptance throughout the aviation industry. The FAA has determined an optimum size and configuration which this Association agrees with. This should become a part of the revised Part 139 if the FAA NPRM is accepted. If this optimum overrun/safety area cannot be constructed on the end of a runway, then a modified safety area should be constructed. Attachments 18 and 19 are examples of such innovative safety area designs.

The importance of the safety area centers on the lack of performance compensation for wet or contaminated runway conditions. Accelerate/stop performance is based on tests done by professional test pilots with new airplanes on dry, good condition runways. Snow covered or ice covered runways degrade the stopping capability of the airplanes. This was graphically demonstrated by the World DC-10 which slid off the end of the runway into Boston harbor. If the end of that runway had been a ditch or highway many more people would have certainly died.

Conclusions

We believe the enclosed information should answer the questions raised during our meeting. All of these issues should be addressed in FAR Part 139. The fact that they are not points to the weakness inherent in the present regulation. Please feel free to contact us if we can provide you with any further information.

Sincerely,

Dan Hasse (J.A)

David J. Hasse, Chairman
ALPA Airport Standards Committee

DJH:sg
Attachments

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